

# Daniel™ 3812 Liquid Ultrasonic Flow Meter

for Direct or Remote Mount Meter Electronics





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## Return Material Authorization (RMA)

A Return Material Authorization (RMA) number must be obtained prior to returning any equipment for any reason. Download the RMA form from the Support Services web page by selecting the link below.

[www2.emersonprocess.com/EN-US/BRANDS/DANIEL/SUPPORT-SERVICES/Pages/Support-Services.aspx?](http://www2.emersonprocess.com/EN-US/BRANDS/DANIEL/SUPPORT-SERVICES/Pages/Support-Services.aspx?)

# Signal words and symbols

Pay special attention to the following signal words, safety alert symbols and statements:



Safety alert symbol

This is a safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

---

## **DANGER**

Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.

---

## **WARNING**

Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.

---

## **CAUTION**

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

---

## **NOTICE**

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

---

---

### **Important**

Important is a statement the user needs to know and consider.

---

---

### **Tip**

Tip provides information or suggestions for improved efficiency or best results.

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### **Note**

Note is a “general by-the-way” content not essential to the main flow of information.

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# Important safety instructions

Daniel Measurement and Control, Inc. (Daniel) designs, manufactures and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel strictly adhere both to the information printed on the product and to all instructions provided in this manual prior to installation, operation, and maintenance.

Daniel also urges you to integrate this manual into your training and safety program.

**BE SURE ALL PERSONNEL READ AND FOLLOW THE INSTRUCTIONS IN THIS MANUAL AND ALL NOTICES AND PRODUCT WARNINGS.**

## **WARNING**

Installing, operating or maintaining a Daniel product improperly could lead to serious injury or death from explosion or exposure to dangerous substances. To reduce this risk:

- Comply with all information on the product, in this manual, and in any local and national codes that apply to the product.
- Do not allow untrained personnel to work with this product.
- Use Daniel parts and work procedures specified in this manual.

---

### Product owners (Purchasers):

- Use the correct product for the environment and pressures present. See technical data or product specifications for limitations. If you are unsure, discuss your needs with your Daniel representative.
- Inform and train all personnel in the proper installation, operation, and maintenance of this product.
- To ensure safe and proper performance, only informed and trained personnel should install, operate, repair and maintain this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from:

<http://www.daniel.com>

- Save this instruction manual for future reference.
- If you resell or transfer this product, it is your responsibility to forward this instruction manual along with the product to the new owner or transferee.
- ALWAYS READ AND FOLLOW THE INSTALLATION, OPERATIONS, MAINTENANCE AND TROUBLESHOOTING MANUALS AND ALL PRODUCT WARNINGS AND INSTRUCTIONS.
- Do not use this equipment for any purpose other than its intended service. This may result in property damage and/or serious personal injury or death.

### Product Operation Personnel:

- To prevent personal injury, personnel must follow all instructions of this manual prior to and during operation of the product.
- Follow all warnings, cautions, and notices marked on, and supplied with, this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from:

<http://www.daniel.com>

- Read and understand all instructions and operating procedures for this product.
- If you do not understand an instruction, or do not feel comfortable following the instructions, contact your Daniel representative for clarification or assistance.
- Install this product as specified in the INSTALLATION section of this manual per applicable local and national codes.
- Follow all instructions during the installation, operation, and maintenance of this product.
- Connect the product to the appropriate pressure and electrical sources when and where applicable.
- Ensure that all connections to pressure and electrical sources are secure prior to and during equipment operation.
- Use only replacement parts specified by Daniel. Unauthorized parts and procedures can affect this product's performance, safety, and invalidate the warranty. "Look-a-like" substitutions may result in deadly fire, explosion, release of toxic substances or improper operation.
- Save this instruction manual for future reference.

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# Section 1: Introduction

Daniel 3812 Liquid Ultrasonic Flow Meters have direct mount or remote mount electronic options and various configurations that meet a broad range of customer requirements. Each meter comes fully assembled from Daniel Measurement and Control, Inc. and all parts and assemblies are tested prior to shipment. Refer to the following documents for additional details:

- P/N 3-9000-761 HART® Field Device Specification for Liquid Ultrasonic Flow Meters
- P/N 3-9000-763 Daniel MeterLink Software for Daniel Gas and Liquid Ultrasonic Flow Meters
- P/N 3-9000-767 Daniel Model 3812 Liquid Ultrasonic Flow Meter Maintenance and Troubleshooting Manual

The Daniel 3812 Liquid Ultrasonic Flow Meter technology can be applied to allocation measurement and check metering applications as shown below.

## 1.1 Typical Applications

- Allocation measurement
- Check metering
- Leak detection
- Line balancing
- Batch control
- Loading and off loading
- Offshore
  - FPSO (Floating Production, Storage and Offshore Loading)
  - Offshore Platforms
  - Barges
- Pipelines
  - Crude Oil pipelines
  - Refined product pipelines
- Terminals
  - Loading and off-loading (Ship, barge, truck, railcar, etc...)
  - Tank Farms
- Cavern Storage

## 1.2 Features and benefits

- Explosion-proof transmitter electronics enclosure with CPU Module, Power Supply, Intrinsic Safety Barrier Module
- Intrinsically safe transducer electronics enclosure with the Acquisition Module
- Daniel MeterLink (software for Daniel Ultrasonic Flow Meters)
- HART® and AMS Suite: Intelligent Device Manager communications for PlantWeb™ architecture
- Direct mount or remote mount options electronics
- Reduce unaccounted measurement
- Increase energy savings
- Replaceable transducers while under pressure
- Extensive self diagnostics
- Immediate alarm reporting
- Auto-detected ASCII/RTU Modbus communications protocol
- Interchangeable electronics modules
- Internet-ready communications
- Ethernet access
- Modbus TCP/IP
- On-board LED status indicators
- Analog pressure and temperature inputs
- Local display and glass endcap (optional)

For other features and benefits refer to the product datasheet at

<http://www2.emersonprocess.com/EN-US/BRANDS/DANIEL/FLOW/Pages/Flow.aspx>



## 1.3 Acronyms, abbreviations and definitions

Table 1-1 Acronyms, abbreviations and definitions

Acronym or abbreviation	Definition
°	degree (angle)
°C	degrees celsius (temperature unit)
°F	degrees fahrenheit (temperature unit)
ADC	analog-to-digital converter
AI	analog input
AMS® Device Manager	Asset Management Software - Device Manager
AO	analog output
ASCII MODBUS	A Modbus protocol message framing format in which ASCII characters are used to delineate the beginning and end of the frame. ASCII stands for American Standard Code for Information Interchange.
boolean	a type of data point that can only take on values of TRUE or FALSE (generally TRUE is represented by a value of 1, FALSE is represented by a value of 0)
bps	bits per second (baud rate)
cPoise	centipoise (viscosity unit)
CPU	central processing unit
CTS	Clear-to-Send; the RS-232C handshaking signal input to a transmitter indicating that it is okay to transmit data — i.e., the corresponding receiver is ready to receive data. Generally, the Request-to-Send (RTS) output from a receiver is input to the Clear-to-Send (CTS) input of a transmitter.
DAC	Digital-to-Analog Converter
Daniel MeterLink™	Daniel ultrasonic meter interface software
DI	digital input
Direct Mount	Transmitter electronics enclosure and base electronics enclosure is directly mounted to meter body
DO	digital output
DHCP	Dynamic Host Configuration Protocol
dm	decimeter ( $10^{-1}$ meters, length unit)
ECC	Error Correction Code
EEPROM	Electrically-Erasable, Programmable Read-Only Memory
Flash	non-volatile, programmable read-only memory

**Table 1-1 Acronyms, abbreviations and definitions**

Acronym or abbreviation	Definition
FODO	output that is user configurable as either a frequency or digital output
HART® Communication Protocol	Highway Addressable Remote Transducer communications protocol
hr	hour (time unit)
Hz	Hertz (cycles per second, frequency unit)
I/O	Input/Output
IS	Intrinsically Safe
K	Kelvin (temperature unit)
kHz	kilohertz ( $10^3$ cycles per second, frequency unit)
LAN	Local Area Network
LED	light-emitting diode
m	meter (length unit)
m <sup>3</sup> /d	cubic meters per day (volumetric flow rate)
m <sup>3</sup> /h	cubic meters per hour (volumetric flow rate)
m <sup>3</sup> /s	cubic meters per second (volumetric flow rate)
mA	milliamp (current unit)
MAC Address	Media Access Control (Ethernet Hardware Address -EHA)
microinch (μinch)	microinch ( $10^{-6}$ in)
micron	micrometer ( $10^{-6}$ m)
MMU	Memory Management Unit
MPa	Megapascal (equivalent to $10^6$ Pascal) (pressure unit)
N/A	not applicable
Nm <sup>3</sup> /h	normal cubic meters per hour
NOVRAM	non-volatile random access memory
Pa	Pascal, equivalent to 1 newton per square meter (pressure unit)
Pa·s	Pascal Second (viscosity unit)

**Table 1-1 Acronyms, abbreviations and definitions**

Acronym or abbreviation	Definition
PC	Personal Computer
PFC	peripheral field connection (board)
P/N	part number
PS	power supply (board)
psi	pounds per square inch (pressure unit)
psia	pounds per square inch absolute (pressure unit)
psig	pounds per square inch gage (pressure unit)
R	Radius
rad	radian (angle)
RAM	Random Access Memory
Remote Mount Option	Detaching the transmitter electronics enclosure and base electronics enclosure from meter body and mounting and affixing them with the mounting bracket to a pole or other structure.
RTS	Request-to-Send; the RS-232C handshaking signal output by a receiver when it is ready to receive data
RTU MODBUS	A Modbus protocol framing format in which elapsed time between received characters is used to separate messages. RTU stands for Remote Terminal Unit.
s	second (time unit, metric)
SDRAM	Synchronous Dynamic Random Access Memory
sec	second (time unit, U.S. Customary)
TCP/IP	Transmission Control Protocol/Internet Protocol
time_t	seconds since Epoch (00:00:00 UTC Jan. 1, 1970) (time unit)
UDP	User Datagram Protocol
U.L.	Underwriters Laboratories, Inc. - product safety testing and certification organization
V	volts (electric potential unit)
W	watts (power unit)

## 1.4 Daniel MeterLink software

Daniel MeterLink software has robust features for setting communications parameters, calibrating your meter, collecting logs and reports and monitoring the meter health and alarm statuses. Daniel MeterLink may be downloaded at no charge from:

<http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/MeterLink.aspx>

**Figure 1-1 Daniel MeterLink download and registration**

DANIEL MEASUREMENT AND CONTROL

United States



**MeterLink 1.10 diagnostic software for ultrasonic meters. March 2013**

**No charge**

Diagnostic and monitoring software providing enhanced reliability and functionality for the 3400, 3410, 3800 and 3812 Daniel Ultrasonic Flow Transmitters.

Daniel's new MeterLink software gives users access to information not seen before. And not simply more data, but actionable, critical information presented in an intuitive graphical format that takes complexity out of your flow measurement. Delivered to the right person at the right time, this information will empower your staff to work predictively, instead of reactively.

[See more information on our products page](#)

 **Order Now**

1. From the right panel under Quick Links, click the **MeterLink Registration and Download** link.
2. Click the **Order Now** button to complete the Online registration form.
3. Click **Next** to go to the order confirmation page.
4. Click **Complete Order**.  
You will receive a conformation email with a hyperlink directing you to the download site. Click the link provided.
5. Click **Save**.

Refer to the *Daniel MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (P/N 3-9000-763) for installation instructions and setup for initial communications. You may download the manual from the Daniel MeterLink web page:

<http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/MeterLink.aspx>

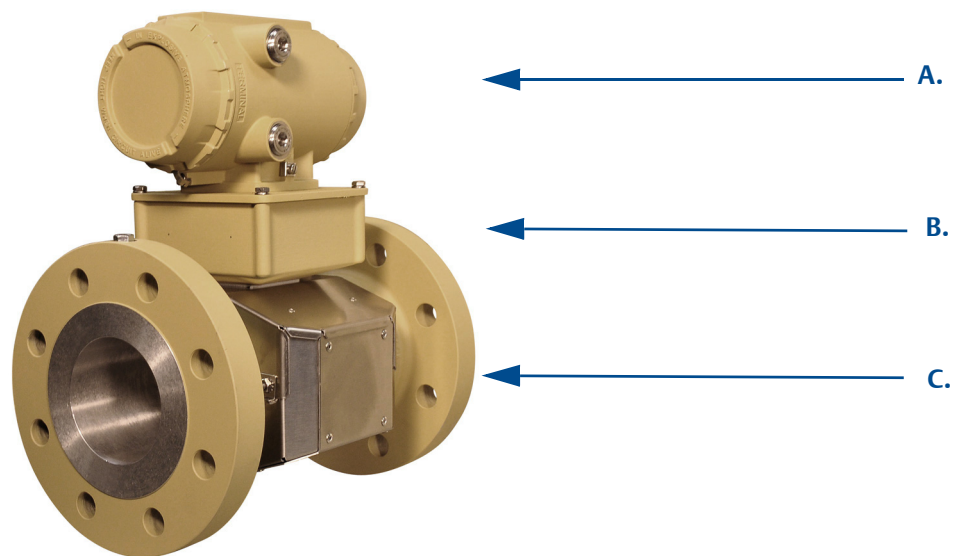
## 1.5 Daniel 3812 Liquid Ultrasonic Flow meter design

The Daniel 3812 Liquid Ultrasonic Flow Meter designs include a direct or remote mount electronics option and depending on the meter's outside diameter, have a shroud cover protecting the transducers and cable assemblies. See [Table 2-1](#) and the list below for meter body shroud types.

Shroud options are:

- split shroud
- bolted band shroud
- latched single band shroud
- clamped band shroud

**Figure 1-2 Direct mount electronics assembly with split shroud**

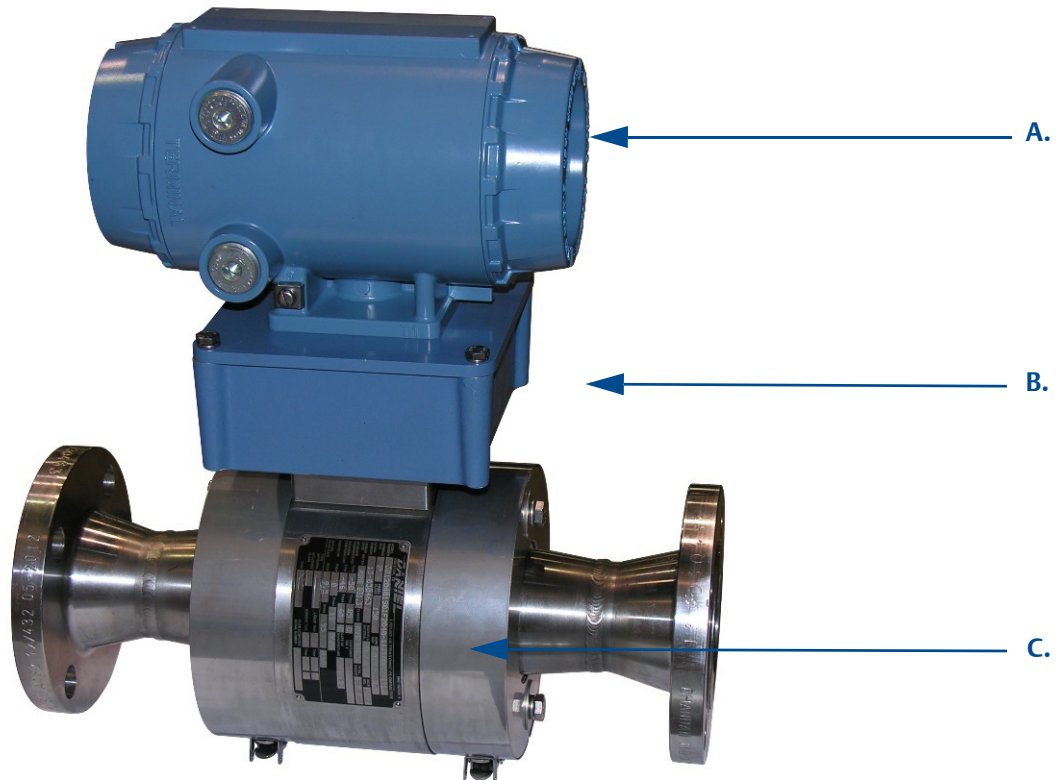


**A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)**

**B. Intrinsically-safe base enclosure includes Acquisition Module**

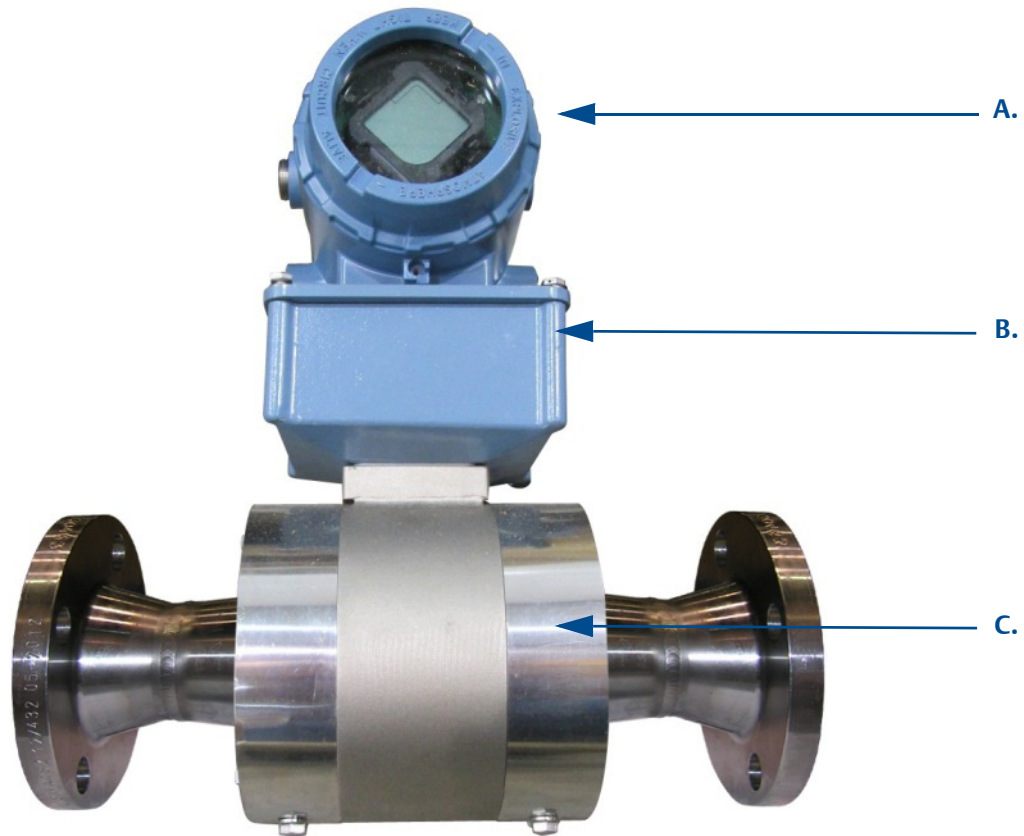
**C. Meter - body and split shroud for transducers and cables assemblies**

**Figure 1-3 Direct mount electronics with latched single band shrouds and remote display**



- A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)**  
**B. Intrinsically-safe base enclosure includes Acquisition Module**  
**C. Meter - body and latched band shrouds for transducers and cable assemblies**

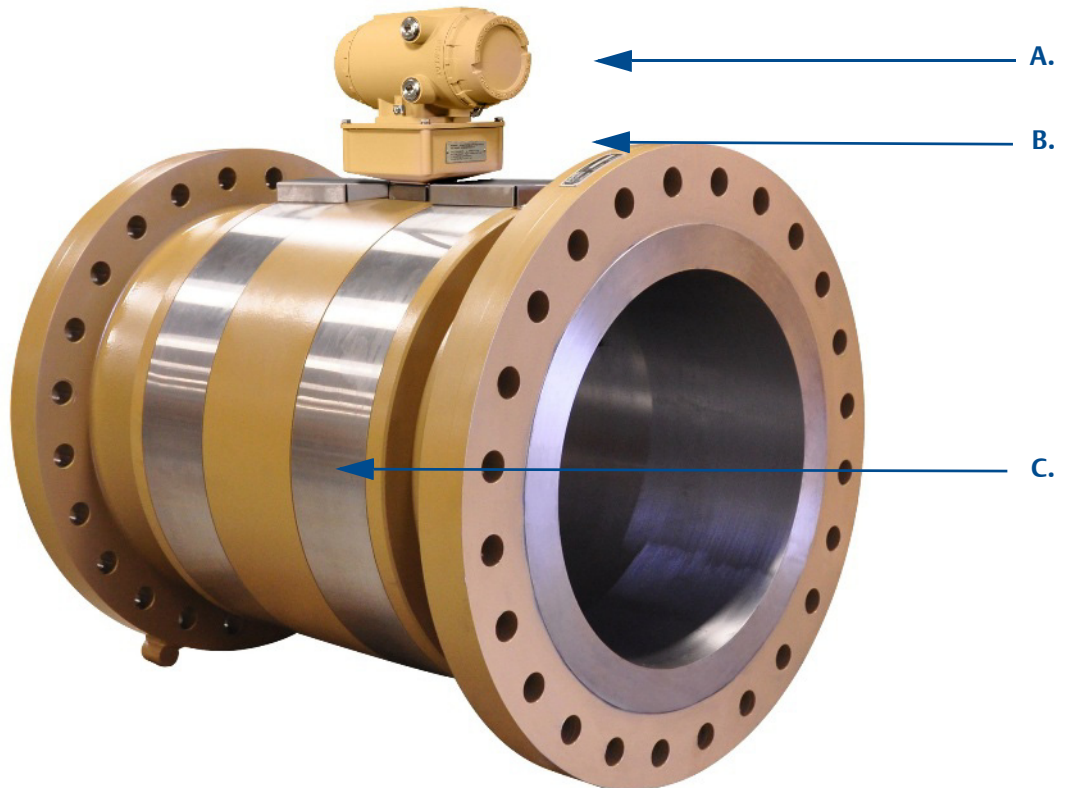
**Figure 1-4 Direct mount electronics with bolted single band shrouds and local display**



- A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)**
- B. Intrinsically-safe base enclosure includes Acquisition Module**
- C. Meter - body and latched band shrouds for transducers and cable assemblies**

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**Figure 1-5 Direct mount electronics assembly with clamped band shrouds**

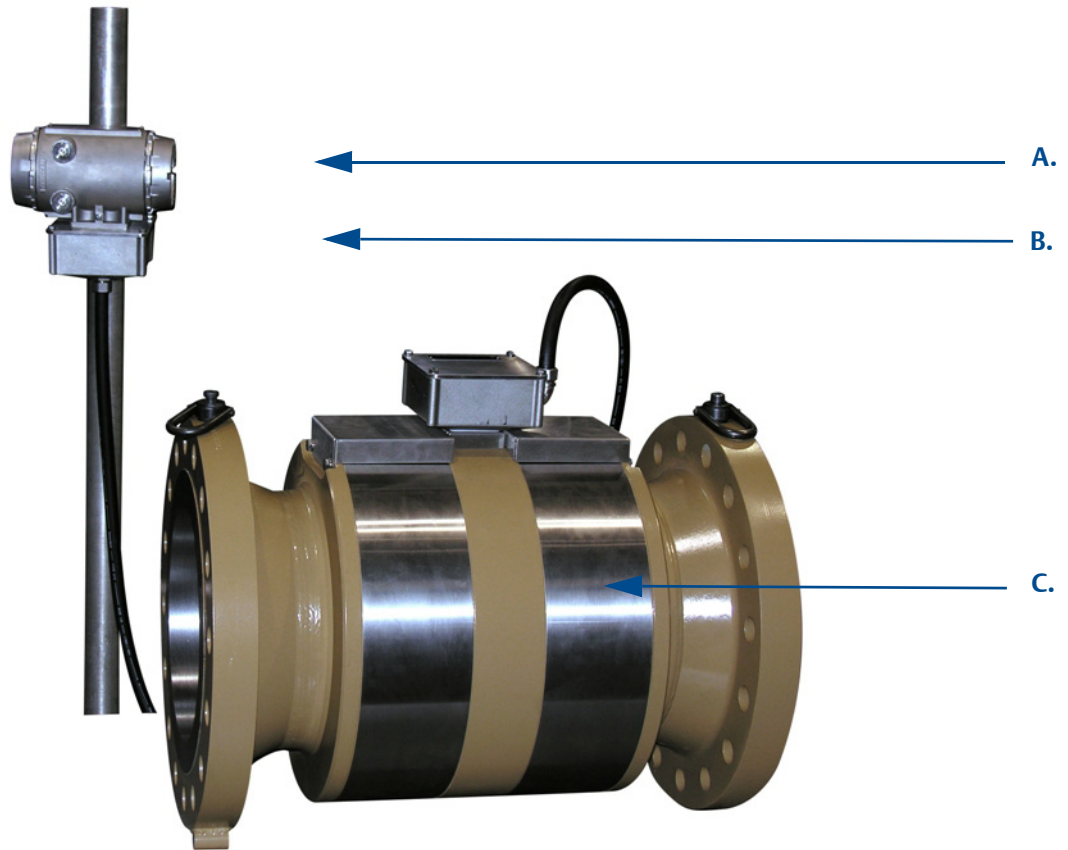


- A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, optional LCD Board with glass endcap)
  - B. Intrinsically-safe base enclosure includes Acquisition Module
  - C. Meter - body and band shrouds for transducers and cable assemblies
-



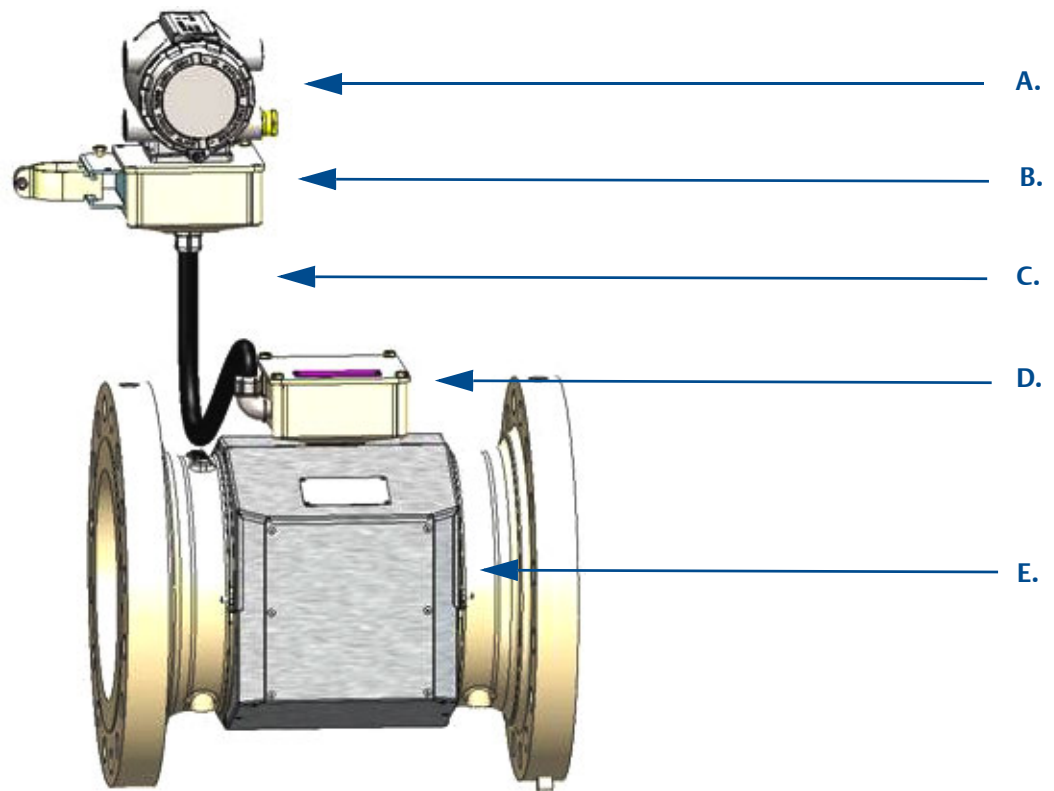
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**Figure 1-6 Remote mount electronics assembly with clamped band shrouds**

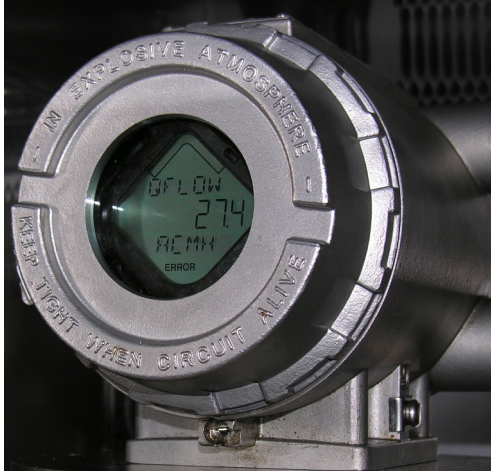


- A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)**  
**B. Intrinsically-safe base enclosure includes Acquisition Module**  
**C. Meter - body and band shrouds for transducers and cable assemblies**
-

Figure 1-7 Remote mount electronics assembly with split shrouds



**Figure 1-8 Optional local display and glass endcap**



The Daniel 3812 Liquid Ultrasonic Flow Meter is a two-path (four transducers) in-line meter designed to measure the difference in signal transit time with and against the flow across one or more measurement path(s). A signal transmitted in the flow direction travels faster than one transmitted against the flow direction. Each measurement path is defined by a transducer pair in which each transducer alternately acts as transmitter and receiver. The meter uses transit time measurements and transducer location information to calculate the mean velocity.

Computer simulations of various velocity profiles demonstrate that multiple measurement paths provide an optimum solution for measuring asymmetric flow. The Daniel 3812 Liquid Ultrasonic Flow Meter utilizes two cross-bore, parallel-plane measurement paths, offers a high degree of repeatability, bi-directional measurement and superior low-flow capabilities without the compromises associated with conventional technologies.

The Daniel 3812 Liquid Ultrasonic Flow Meter's U.L. safety listing is accomplished through the combination of an explosion-proof Transmitter Electronics Enclosure that houses the CPU Module, Power Supply board, I.S. Barrier board, Backplane board and optional LCD Display board.

**NOTE:** The optional LCD Display requires firmware v1.04 and Uboot version, January 31, 2013.

The Base Electronics Enclosure is intrinsically safe and houses the Acquisition Module, the acquisition cable and wiring. The Intrinsically safe transducers and cable assemblies are designed for Class 1, Division 1, Groups C and D areas without need of further protection when installed in accordance with the field wiring diagram (refer to Daniel drawing DMC - 004936, [see Appendix A](#) and [Section 1.8](#)).

## 1.6 Meter specifications

### CAUTION

#### ESCAPING FLUIDS HAZARD

**The purchaser of the meter is responsible for the selection of Daniel components/seals and materials compatible with the chemical properties of the measurement fluid.**

Failure to select suitable meter components/seals may cause escaping fluids, resulting in injury or equipment damage.

Consult your Daniel Sales and Service representative to ensure you purchase the correct components and seals for your application.

**Table 1-2 Meter specifications**

Liquid Ultrasonic Flow Meter specifications	
Meter type	Number of paths <ul style="list-style-type: none"> <li>Two path (four transducer) chordal design</li> </ul>
	Ultrasonic type <ul style="list-style-type: none"> <li>Transit-time based measurement</li> <li>Spool piece with integral mount transducers</li> </ul>
Meter Performance	
Linearity	<ul style="list-style-type: none"> <li>± 0.30% of measured value over a 10:1 turndown (40 to 4 ft/s; 12.2 to 1.2 m/s)</li> </ul>
Repeatability	<ul style="list-style-type: none"> <li>±0.10% of reading in the specified velocity range</li> </ul>
Velocity range	<ul style="list-style-type: none"> <li>40.0 ft/s (12.2 m/s) (nominal) to 2.0 ft/s (0.6 m/s)</li> <li>48 fps (14.3 m/s) (over-range)</li> </ul>
Body and Flange Pressure rating range	U.S. Customary Units sizes - 2, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 28, 30, and 36 (in) <ul style="list-style-type: none"> <li>ANSI pressure classes 150 and 300, 600, 900 (per ANSI B16.5)</li> <li>Carbon Steel</li> <li>316 Stainless Steel</li> </ul> Metric Units sizes <ul style="list-style-type: none"> <li>DN 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, and 900</li> <li>PN 20, 50, 100, 150</li> <li>Carbon Steel</li> <li>316 Stainless Steel</li> </ul> Meter bore <ul style="list-style-type: none"> <li>Schedule 40 and Schedule 80</li> </ul> Maximum Pressures <ul style="list-style-type: none"> <li>Dependent on operating temperature</li> </ul>
Flange types	ANSI classes - 150, 300, 600 and 900 <ul style="list-style-type: none"> <li>Raised face or RTJ</li> </ul>
Specific Gravity	0.35 to 1.50
Accuracy Limits	Accuracy limits typically are: <ul style="list-style-type: none"> <li>± 2% without a flow calibration, ± 0.3% with flow calibration</li> </ul>
Minimum operating pressure	<ul style="list-style-type: none"> <li>0 psig</li> <li>0 barg</li> </ul>

Table 1-2 Meter specifications

Electronic specifications	
Power	<p>Meter</p> <ul style="list-style-type: none"> <li>10.4 VDC to 36 VDC measured at the meter terminals<sup>1</sup></li> <li>11 W maximum power consumption</li> </ul> <p>Serial cable</p> <ul style="list-style-type: none"> <li>Belden #9940 or equivalent (22 gauge) <ul style="list-style-type: none"> <li>Capacitance (pF/m) 121.397 (conductor to conductor)</li> <li>Capacitance (pF/m) 219.827 (conductor to other conductor and shield)</li> <li>Resistance (DC) DCR @ 20 °C (Ohm/km) 48.2307</li> <li>Nominal Outer shield resistance - DCR @ 20°C (Ohm/km) 16.405</li> <li>Operating voltage - 300 V RMS (UL AWM Style 2464)</li> <li>Current 2.4 Amps per conductor @ 25°C (recommended)</li> </ul> </li> </ul> <p>Ethernet cable</p> <ul style="list-style-type: none"> <li>Cat-5 Standard 100Mbps</li> </ul> <p>Frequency (see Table 3-1)</p> <ul style="list-style-type: none"> <li>22 AWG wire characteristics are as follows: <ul style="list-style-type: none"> <li>Capacitance = 20 pF/ft or 20 nF/1000 ft (between two wires)</li> <li>Resistance = 0.0168 Ohms/ft or 16.8 Ohms/1000 ft</li> <li>Pull-up voltage is 24 VDC</li> </ul> </li> </ul>
Temperature flameproof transmitter electronic enclosure and base electronic enclosure	<ul style="list-style-type: none"> <li>Ambient: -40 °F to 140 °F (-40 °C to 60 °C)</li> <li>Storage: -58 °F to 185 °F (-50 °C to 85 °C)</li> </ul> <p><b>Note:</b> The transmitter electronics enclosure and base enclosure must be remote mounted if the operating temperature exceeds 140 °F (60 °C).</p>
Transducers	<ul style="list-style-type: none"> <li>LT-10 and LT-11 Operating temperature range with NBR O-rings -58 °F to +275 °F (-50 °C to 135 °C)</li> <li>LT-10 and LT-11 Operating temperature range with FKM O-rings -40 °F to +302 °F (-40 °C to +150 °C)</li> </ul> <p><b>Note:</b> The process temperature must not exceed the operating temperature range of the transducers.</p> <p><b>Note:</b> LT-10 transducers are designed for 4 inch to 10 inch meters. LT-11 transducers are designed for 12 inch and larger meters.</p> <p><b>Note:</b> The ultrasonic transducers are not intended for use across boundary walls of different hazardous area classifications. The transmitter electronics cannot be remote mounted from a Division 1 classification to a Division 2 area to meet an area classification.</p>
Acquisition Cable	<ul style="list-style-type: none"> <li>Total cable length between the Acquisition Module and ultrasonic transducers must not exceed 15 feet (4.7 meters) when using the remote mount option (see Figure 1-7)</li> </ul>

Table 1-2 Meter specifications

Communications specifications	
Connectivity protocols	One serial RS-232/RS-485 port (115 kbps baud rate) (Modbus RTU/ASCII) <ul style="list-style-type: none"> <li>(1) Serial Port A (RS-232/RS-485 Full Duplex/RS-485 Half Duplex)</li> </ul>
	One Ethernet Port (TCP/IP) 100 BaseT <ul style="list-style-type: none"> <li>Modbus TCP</li> </ul>
Device compatibility	FloBoss 103, FloBoss S600 flow computer, ROC 107
Digital, analog, and frequency inputs	
Digital Input(s) (Selectable)	(1) Single polarity (for flow calibration gating - contact closure) <ul style="list-style-type: none"> <li>Single input for starting and stopping</li> <li>Four pulse configurations available</li> </ul>
Analog Input(s)	(2) 4-20 mA <ul style="list-style-type: none"> <li>AI-1 Temperature</li> <li>AI-2 Pressure</li> </ul> <p><b>Note:</b> The analog-to-digital conversion accuracy is within <math>\pm 0.05\%</math> of full scale over the operating temperature range.</p> <p><b>Note:</b> AI-1 and AI-2 are electronically isolated and operate in sink mode. The input contains a series resistance so HART® Communicators can be connected to configure sensors.</p> <p>A 24 Volt DC power supply is available to provide power to the sensors.</p>

Table 1-2 Meter specifications

Digital, analog, and frequency outputs	
Frequency/Digital Output(s)	<p>The meter has user-configurable selections for either a frequency output or Digital status (FODO) (Also see <a href="#">Section 3.6.1</a>)</p> <p>(3) Frequency/Digital Outputs</p> <ul style="list-style-type: none"> <li>FODO1 (four possible output configurations)</li> <li>FODO2(eight possible output configurations)</li> <li>FODO3(eight possible output configurations)</li> </ul> <p>Frequency or Digital Output parameter pairs (<a href="#">see Section 3.6.1</a>)</p> <p>Frequency or Digital Outputs (FODO 1) source selections:</p> <ul style="list-style-type: none"> <li>(FO1A, DO1A, FO1B, DO1B)</li> </ul> <p>Frequency or Digital Outputs (FODO 2) source selections</p> <ul style="list-style-type: none"> <li>(FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B)</li> </ul> <p>Frequency or Digital Outputs (FODO 3) source selections</p> <ul style="list-style-type: none"> <li>(FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B)</li> </ul> <p>Mode options:</p> <ul style="list-style-type: none"> <li>Open Collector (requires external excitation supply voltage and pull-up resistor)</li> <li>TTL (internally powered by the meter 0-5 VDC signal)</li> </ul> <p>Channel B Phase options:</p> <ul style="list-style-type: none"> <li>Lag forward, Lead reverse (Phase B lags Phase A while reporting forward flow, leads Phase A while reporting reverse flow)</li> <li>Lead forward, Lag reverse (Phase B leads Phase A while reporting forward flow, lags Phase A while reporting reverse flow)</li> </ul> <p>Phase A and Phase B output (based on flow direction)</p> <ul style="list-style-type: none"> <li>Reverse flow - output only reports flow in the reverse direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.</li> <li>Forward flow - output only reports flow in the forward direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.</li> <li>Absolute - output reports flow in both directions. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.</li> <li>Bidirectional - output reports flow on Phase A only in the forward direction and on Phase B only in the reverse direction.</li> </ul> <p>Maximum frequency for the frequency outputs</p> <ul style="list-style-type: none"> <li>1000Hz</li> <li>5000Hz</li> </ul>
Analog Output(s)	<ul style="list-style-type: none"> <li>(1) 4-20 mA independently configurable analog output (HART)</li> <li>(1) 4-20 mA independently configurable analog output (conventional)</li> </ul> <p>The analog output zero scale offset error is within <math>\pm 0.1\%</math> of full scale and gain error is within <math>\pm 0.2\%</math> of full scale. The total output drift is within <math>\pm 50</math> ppm of full scale per <math>^{\circ}\text{C}</math>.</p>

## 1.7 Pre-installation considerations

- Pipeline equipment code compliance, ANSI, ASME, etc.
- Proper Inlet/outlet meter tube piping for reasonable stable flow to the settling chamber (first meter tube spool upstream of the meter).
- Electrical safety compliance; UL, CSA, ATEX, IECEx etc.
- Civil and structural good practices compliance
- Contractual agreements or governmental compliance (or both)
- In-situ performance test procedures
- Field tested advanced meter health and flow dynamics diagnostics
- Data collection and retention procedures

## 1.8 Safety

The Daniel 3812 Liquid Ultrasonic Flow Meter is suitable for use in U.L. Class 1, Division 1, Group C and D hazardous locations.

### ⚠ WARNING

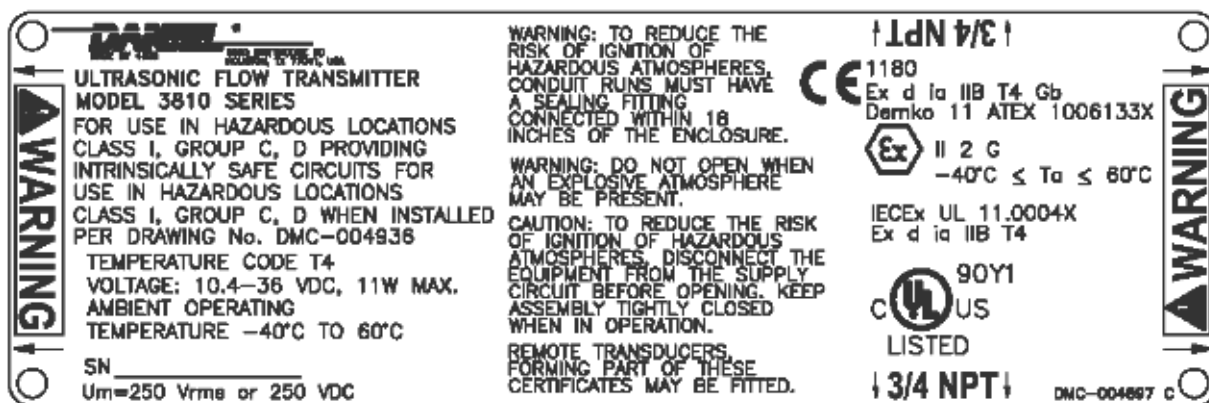
#### DANGER TO PERSONNEL AND EQUIPMENT

Observe all precautionary labels posted on the equipment and safety messages throughout the meter documentation.

Failure to do so may result in injury to personnel or cause damage to the equipment.

The Daniel 3810 Series Liquid Ultrasonic Meter is approved to the ATEX Directive 94/9/EC

Figure 1-9 Daniel 3810 Series Liquid Ultrasonic Meter ATEX approval





## 1.9 Daniel 3812 Certifications and Approvals

Daniel 3810 Series Liquid Ultrasonic Flow Meters have electrical, metrology, intrinsic safety and Pressure Equipment Directive certifications, approvals and lab testing and calibration certifications by the agencies listed below. Refer to the nameplate tag on the meter body, the wiring diagram (Drawing DMC - 0004936) in [Appendix A](#) and observe all safety precautions. Daniel 3810 Series Liquid Ultrasonic Flow Meters operate within the pressure and temperature range of the device (also [see Section 1.6](#) for meter specifications).

The Daniel 3810 Series Liquid Ultrasonic Flow Meters certifications and approvals are available from Daniel Measurement and Control, Inc.

- ATEX (British Approval Service for Electrical Equipment in Flammable Atmospheres)
- IECEx (International Electrotechnical Commission for explosive atmospheres)
- U.L. (Underwriter Laboratories)
- U.L.C. (Underwriter Laboratories of Canada)
- PED (BSI Group) British Standards Institution
- INMETRO (National Institute of Metrology, Quality and Technology)
- Demko (Dansk Elektrisk Materiel Kontrol - Danish Electrical Equipment Supervision)
- GOST R (Government Standard Russia)
- L.A.B. (Laboratory Accreditation Bureau) ISO/IEC 17025:2005

## 1.10 FCC compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### **NOTICE**

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



## Section 2: Mechanical installation

### 2.1 Meter piping, lifting and mounting

Refer to the following sections for piping recommendations, lifting with hoist rings and slings, mounting in heated or cooled pipelines and safety warnings and precautions.

#### CAUTION

##### **SURFACE TEMPERATURE HAZARD**

**The meter body and piping may be extremely hot or cold.**

Wear appropriate personal protective equipment when coming in contact with the meter. Failure to do so may result in injury.

#### WARNING

##### **CUTTING HAZARD**

**Sharp edges may be present on the meter.**

Wear appropriate personal protective equipment when working on the meter. Failure to do so may cause serious injury

#### CAUTION

##### **TRANSPORTATION HAZARD**

**When moving the meter, do not insert the forks of a forklift into the bore.**

Inserting the forks may cause the meter to become unstable, resulting in injury or damage to the bore and sealing face.

#### CAUTION

##### **TRIPPING HAZARD**

**Clear all obstacles or obstructions from the work area when transporting, installing or removing the meter.**

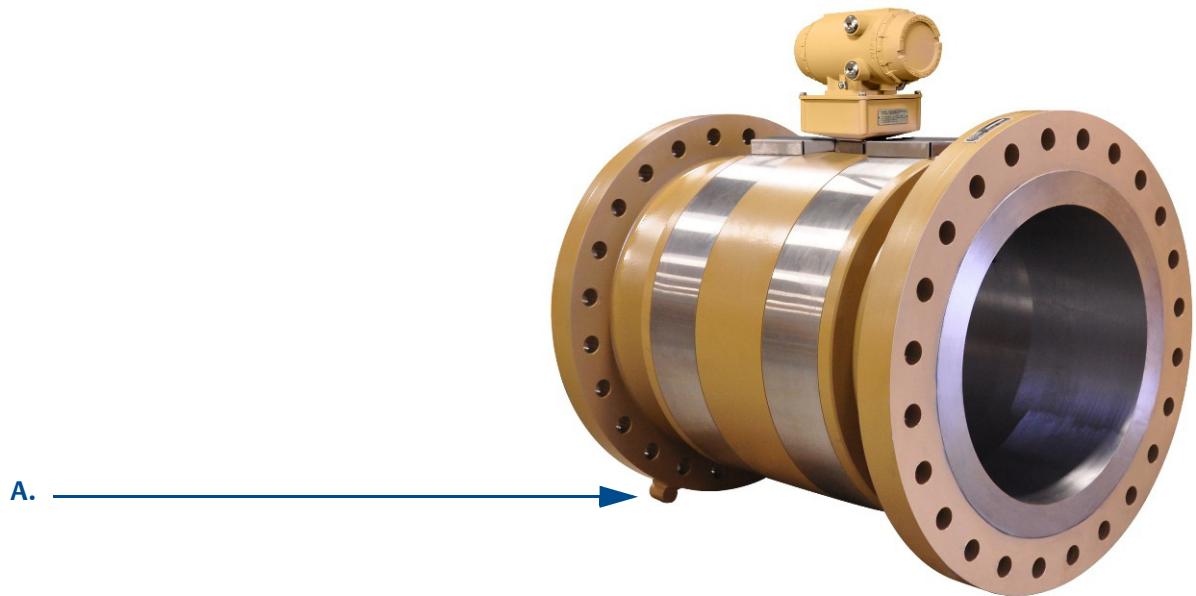
Failure to clear the work area may cause injury to personnel.

## **⚠ WARNING**

### **CRUSHING HAZARD**

**Do not remove flange stabilizers.**

Attempting to do so may allow the meter to roll, resulting in serious injury or equipment damage.



**A. Flange stabilizers**

## **⚠ CAUTION**

### **ESCAPING FLUIDS HAZARD**

**The purchaser of the meter is responsible for the selection of Daniel components/seals and materials compatible with the chemical properties of the measurement fluid.**

Failure to select suitable meter components/seals may cause escaping fluids, resulting in injury or equipment damage.

Consult your Daniel Sales and Service representative to ensure you purchase the correct components and seals for your application.

## Meter components

### **⚠ WARNING**

#### **FLUID CONTENTS MAY BE UNDER PRESSURE**

**When the meter is under pressure, DO NOT attempt to remove or adjust the transducer housing.**  
Attempting to do so may release pressurized fluid, resulting in serious injury or equipment damage.

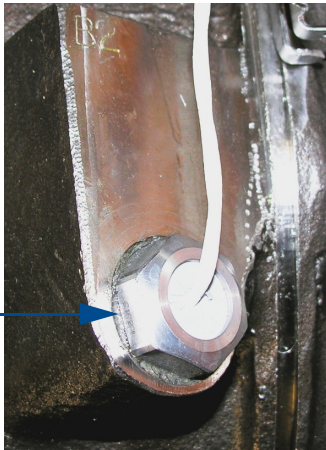
### **⚠ WARNING**

#### **FLUID CONTENTS MAY BE HAZARDOUS**

**The meter must be fully depressurized and drained before attempting to remove the transducer housing.**  
**If fluid begins to leak from the transducer housing, immediately reinstall it.**

Failure to do so may cause serious injury or equipment damage.

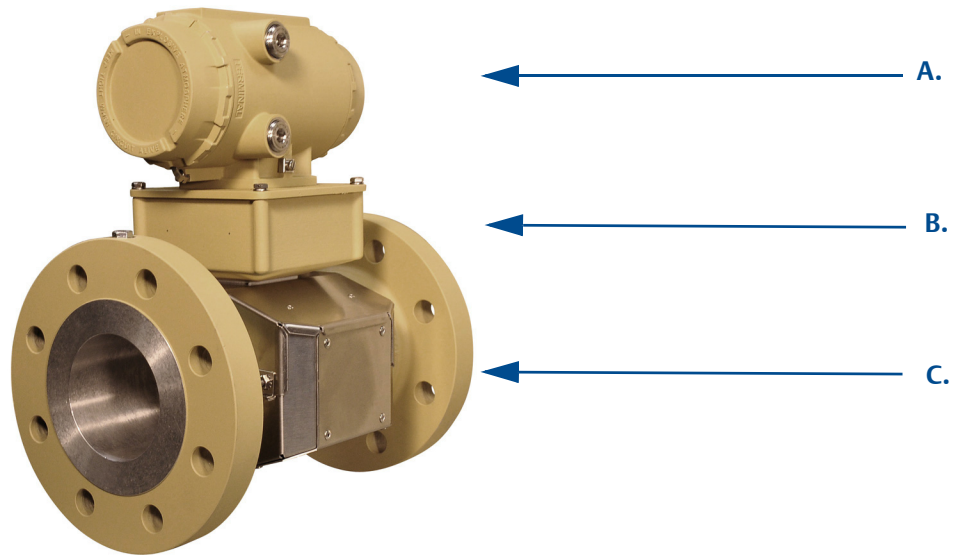
A. \_\_\_\_\_



**A. Transducer housing**

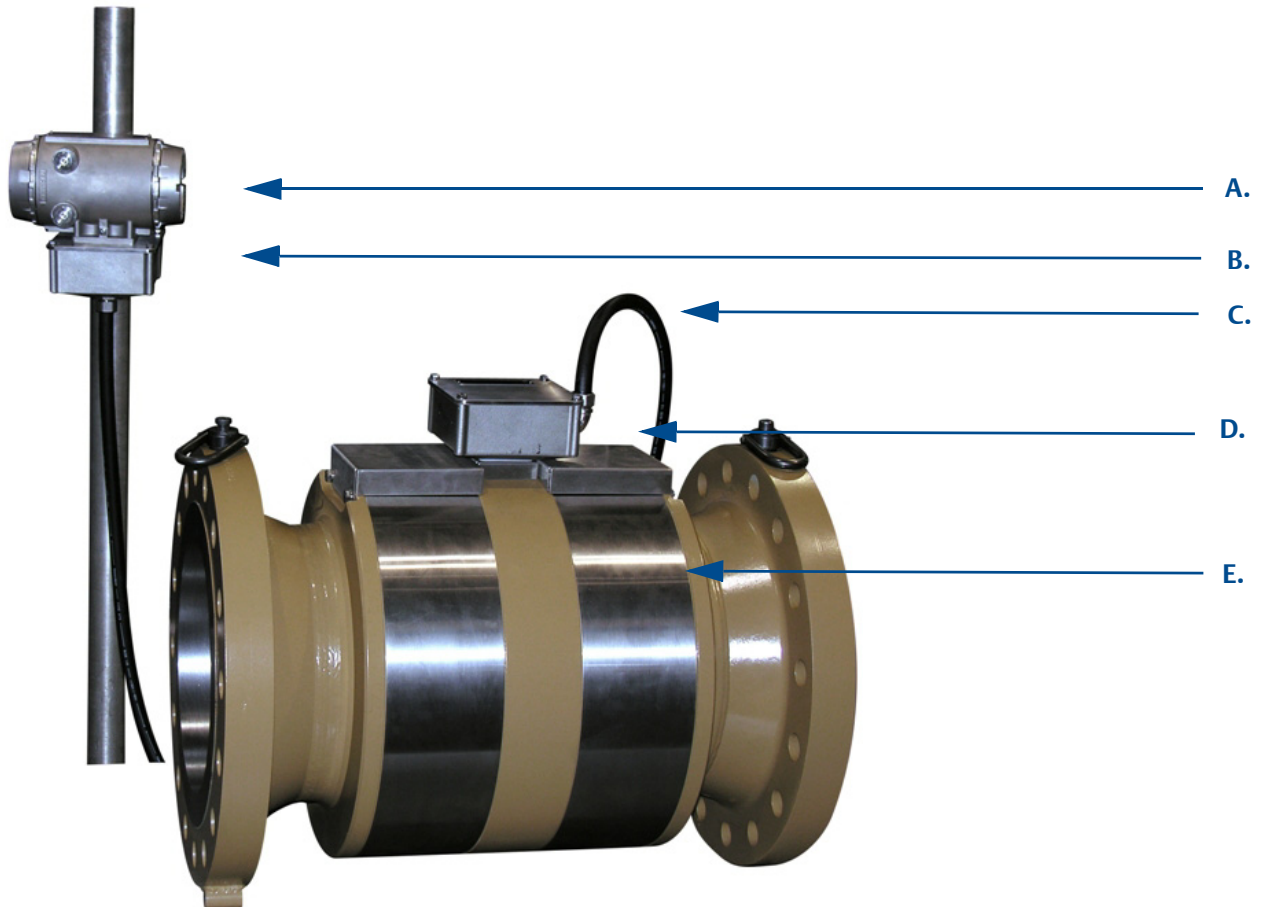
Daniel Liquid Ultrasonic Flow Meters are assembled, configured, and tested at the factory. The meter components include the transmitter electronics enclosure, the base electronics enclosure, the meter body with shroud covers for the transducers and cable assemblies and a direct or remote mount option.

**Figure 2-1 Direct mount meter electronics assembly with split shroud**



- A. Direct mount- explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane Board, and optional LCD Display Board with glass endcap)**  
**B. Intrinsically-safe base enclosure includes Acquisition Module**  
**C. Meter - body and split shroud cover for transducers and cables assemblies**

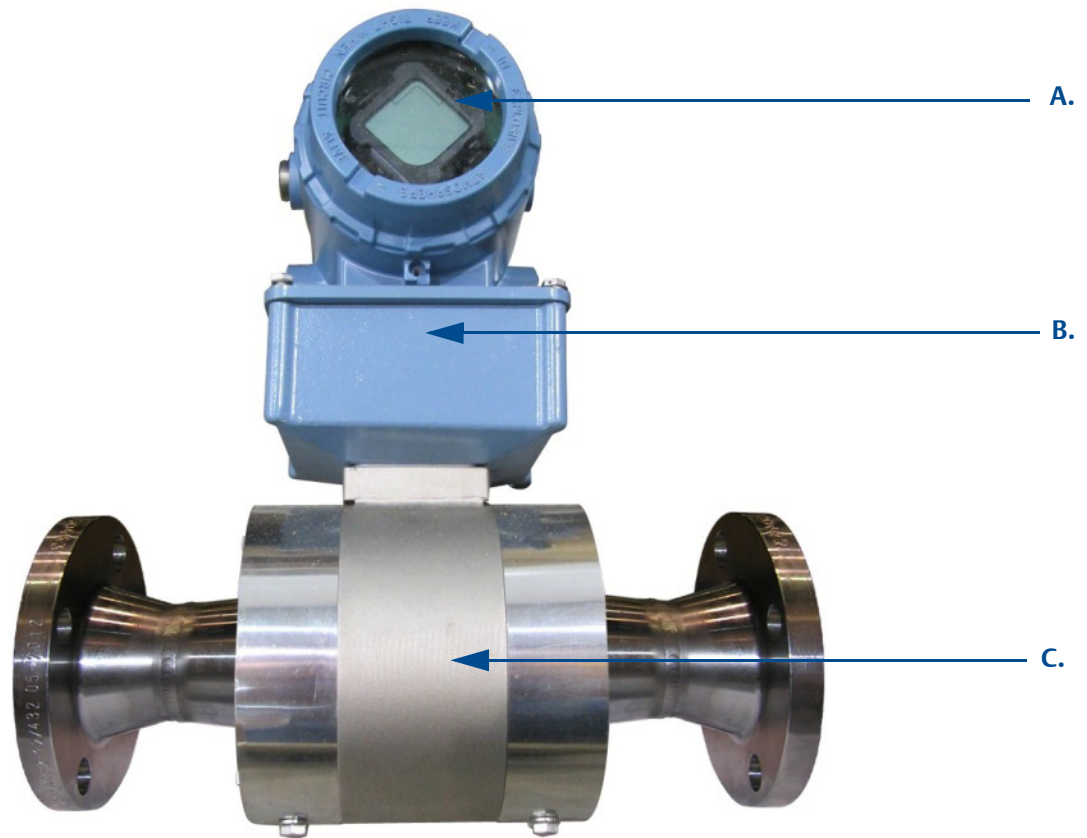
Figure 2-2 Remote mount meter electronics assembly with split shroud



- A. Remote mount explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. I.S. Barrier Board, Backplane Board and optional LCD Display Board)
- B. Intrinsically-safe base enclosure includes Acquisition Module
- C. Acquisition cable conduit
- D. Junction box with acquisition cable terminal blocks
- E. Meter - body and split shroud cover for transducer assemblies and cables

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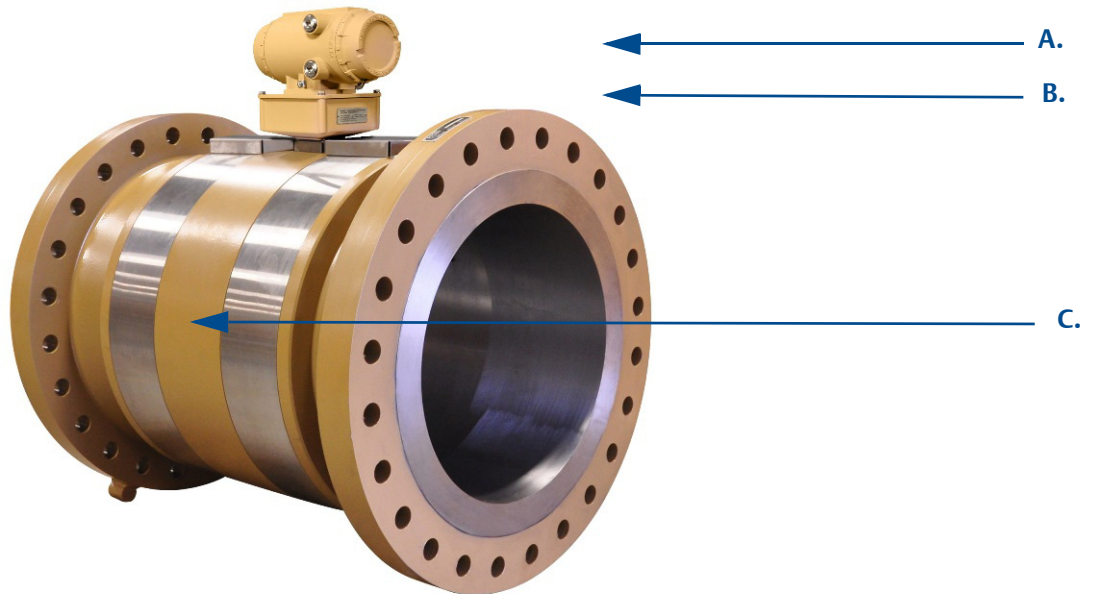
**Figure 2-3 Direct mount meter electronics with bolted band shrouds**



- A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane Board and optional LCD Board with glass endcap)**  
**B. Intrinsically-safe base enclosure includes Acquisition Module**  
**C. Meter - body and split shroud cover for transducers and cables assemblies**
-



Figure 2-4 Direct mount meter electronics assembly with clamped band shrouds



- A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board and Backplane Board)  
B. Intrinsically-safe base enclosure includes Acquisition Module  
C. Meter - body and split shroud cover for transducers and cables assemblies

Table 2-1 3812 Ultrasonic Meter shrouds options per ANSI pressure rating

Meter body size	ANSI pressure rating	Shroud type
2" - 3"	150 and 300	Bolted band shroud or latched band shroud
4" - 10"	150 and 300	Split shroud or latched band shroud
	600 and 900	Clamped band shroud
12" and larger	150, 300, 600, 900	Clamped band shroud

## 2.2 Piping recommendations

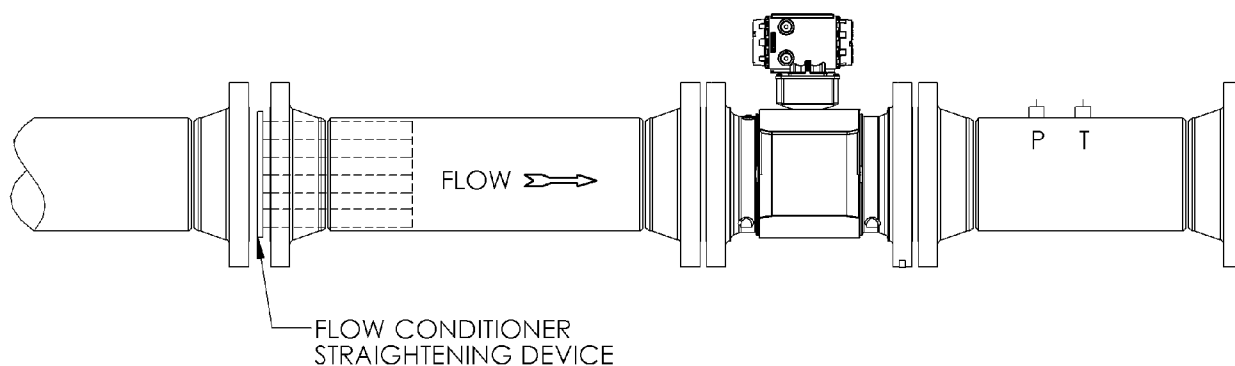
### **⚠ WARNING**

#### **BURST HAZARD**

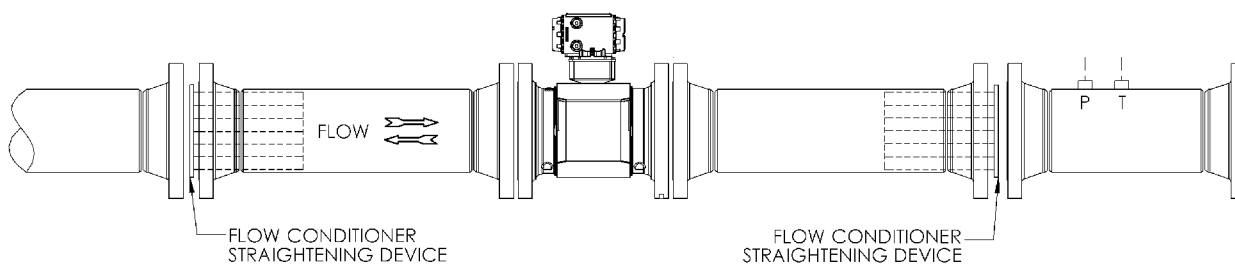
**Before pipeline cleaning and maintenance (“pigging operations”), remove straightening vanes or flow conditioners.**

Failure to do so may cause excessive pressure in the meter system, resulting in serious injury/ death or equipment damage.

3812 Ultrasonic Flow Meter with flow conditioner for unidirectional flow



3812 Ultrasonic Flow Meter with flow conditioner for bidirectional flow



Sunshields, provided by the customer, may be required to prevent exceeding the process fluid temperature when the meter is mounted in a location with extremely hot climates.

## CAUTION

### SUNSHIELD PROTECTION

**Install a sunshield to prevent prolonged exposure to direct sunlight in extreme climates.**

Failure to shield the meter may result in exceeding the process temperature range and damage transmitter electronics.

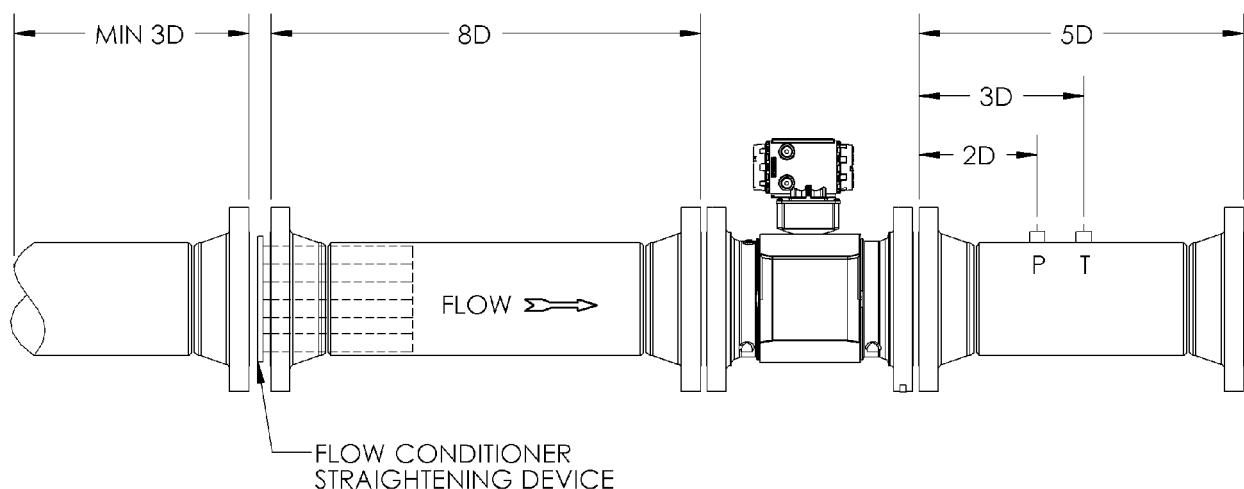
## NOTICE

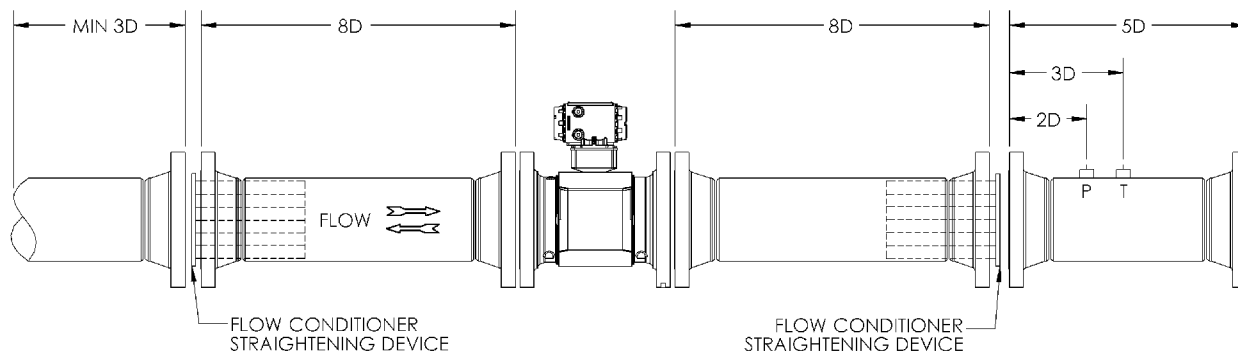
For optimal flow measurement conditions, Daniel suggests the piping configurations below. Regardless of the configuration selected, the user agrees to accept full responsibility for the site piping design and installation.

Flow conditioning is recommended for best measurement results.

- Honed or un-honed meter tube(s)
- Flow direction (unidirectional or bidirectional)
- Correct meter size selection - too low may cause poor flow stability (thermal convection or too fast may cause erosion problems and resonance, cracks or failure of probes or thermowells (approximately .6 to 12 m/sec or 2 to 40 ft/sec).
- Space availability for meter lengths (to allow inlet piping customization)
- Concentric alignment pins or flange concentricity technique considerations

**Figure 2-5 Piping recommendations unidirectional flow**



**Figure 2-6 Piping recommendations bidirectional flow**

All pipe lengths are minimum:

- D = Nominal pipe size in inches (i.e. 6" pipe size;  $10 D = 60$  in)
- P = Pressure measurement location
- T = Temperature measurement location

Refer to the ultrasonic meter product data sheet for piping information. The Liquid Ultrasonic Flow Meter Datasheet may be downloaded from the Daniel website:

<http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/ultrasonic-3812.aspx>

## NOTICE

To access the product datasheet, from the Daniel products page (above link), select the Daniel Liquid Ultrasonic Flow Meter link, click the Documentation tab, expand the Data Sheets - Bulletins - Catalogs tab, then select the Data Sheet.

Meter tube dimensions with tube bundle or profiler plate for uni-directional and bi-directional flow, the minimum straight pipe length is as follows:

**Table 2-2 Piping recommendation for uni-directional or bi-directional flow**

UniDirectional Flow	BiDirectional Flow
8D up stream (with a flow conditioner)	8D up stream (with a flow conditioner)
8D up stream (no flow conditioner)	8D up stream (no flow conditioner)
5D in front of flow conditioners if used	5D in front of flow conditioners if used

- The bore of the mating piping should be within 1% of the meter inside diameter.
- The meter is provided with dowel pins to align the meter body bore with the bore of the mating piping.
- The Daniel Liquid Ultrasonic Flow Meter should be mounted in horizontal piping with the chord paths horizontal

## CAUTION

### FAULTY METER INSTALLATION

#### Correctly install the meter.

If meter bodies are mounted or oriented differently than specified above, debris may collect in the transducer ports which could adversely affect the transducer signals, or cause equipment damage.

- Normally, the meter body is installed so that the electronics assembly is on the top of the meter. If there is insufficient space above the piping for this arrangement, the meter can be ordered with extra long transducer cables for remote mounting or the meter housing can be installed with the electronics assembly on the bottom.
- The mating piping should include temperature and pressure measurement connections located a minimum of two nominal pipe diameters length down stream of the meter, or per API MPMS 5.8.

## 2.3 Meter safety for hoist rings and lifting slings

A Daniel Ultrasonic Meter can be safely lifted and maneuvered into and out of a meter run for installation or service by obeying the following instructions.

### WARNING

#### DANGER TO PERSONNEL AND EQUIPMENT

##### Lifting a Daniel Ultrasonic Meter with other equipment

The following lifting instructions are for installation and removal of the Daniel Ultrasonic Meter **ONLY**. The instructions below do not address lifting the Daniel ultrasonic meter while it is attached, bolted, or welded to meter tubes, piping, or other fittings.

Using these instructions to maneuver the Daniel Ultrasonic Meter while it is still attached, bolted, or welded to a meter tube, piping, or other fitting may result in equipment damage, serious injury, or death.

The operator must refer to their company's hoisting and rigging standards, or the "DOE-STD-1090-2004 Hoisting and Rigging" standard if such company standards do not exist, for lifting and maneuvering any assembled meter tube and associated piping.

### WARNING

#### CRUSHING HAZARD

**During meter installation or removal, always place the unit on a stable platform or surface that supports its assembled weight.**

Failure to do so could allow the meter to roll, resulting in serious injury or equipment damage.

### NOTICE

Prior to lifting the unit, refer to the Daniel 3812 Liquid Ultrasonic Flow Meter nameplate or outline dimensional (general arrangement) drawing for the assembled weight.

When lifting a Daniel Ultrasonic Meter by itself, Daniel recommends two methods. These methods are:

- Using appropriately rated Safety Engineered Swivel Hoist Rings installed in the Daniel Ultrasonic Meter end flanges.
- Using appropriately rated lifting slings positioned at designated areas of the Daniel Ultrasonic Meter.

Both methods must be used in conjunction with all appropriate company hoisting and rigging standards or the [DOE-STD-1090-2004 HOISTING AND RIGGING](#) standard if such company standards do not exist. Refer to the following sections for more information on these two methods.

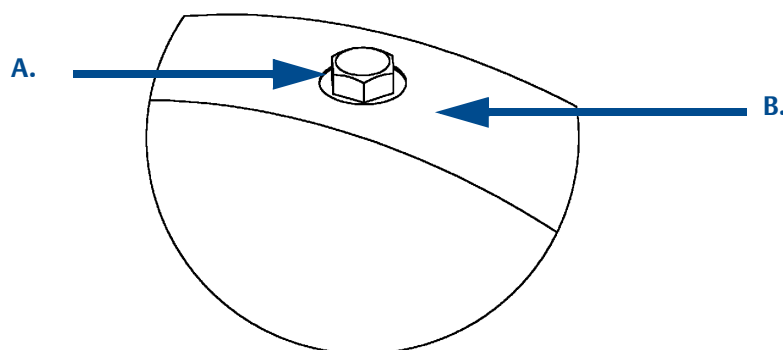
### 2.3.1 Use of appropriate safety engineered swivel hoist rings in meter end flanges

Daniel Ultrasonic meters come equipped with a tapped hole located on the top of each meter body end flange. A flat machined surface surrounds each tapped hole (see [Figure 2-7](#)). This feature provides complete surface contact **ONLY** between the meter flange and an OSHA compliant Safety Engineered Swivel Hoist Ring as shown in [Figure 2-8](#).

Operators **SHALL NOT** use Eye Bolts (see [Figure 2-8](#)) in the Daniel Ultrasonic Meter flange tapped holes to aid in lifting or maneuvering the unit.

Operators **SHALL NOT** use other Hoist Rings that do not fully seat flush with the counter bore on the top of the meter flanges.

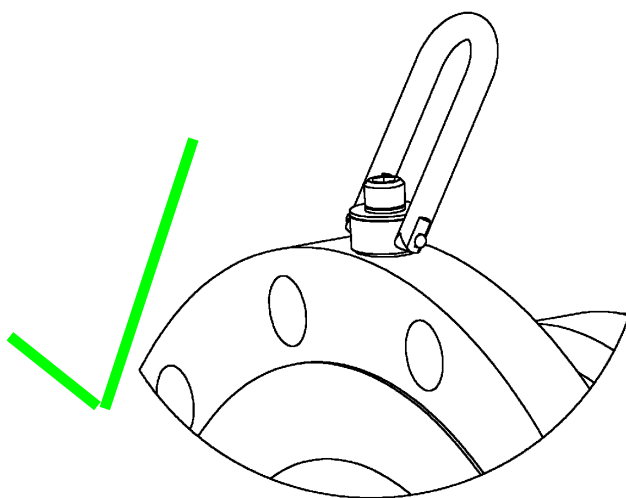
**Figure 2-7 Meter end flange with tapped flat-counterbore hole for hoist ring**



**A. Plug bolt**

**B. Flat counterbore surface**

**Figure 2-8 Safety approved hoist ring and non-compliant eye bolt**



**Safety engineered swivel hoist ring**



**Eye bolt**

### **Safety precautions using safety engineered swivel hoist rings**

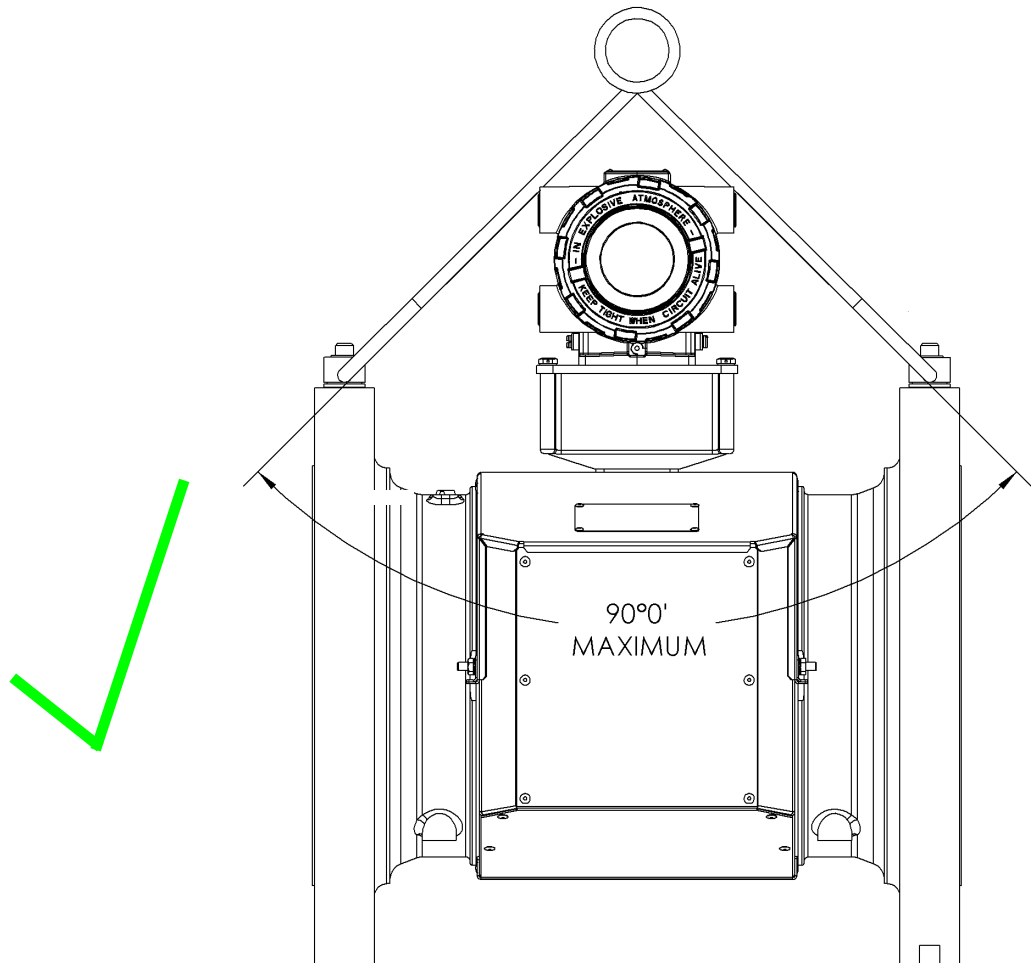
Read and follow the Safety Precautions listed below:

1. Meters must only be lifted by personnel properly trained in the safe practices of rigging and lifting.
2. Remove the plug bolts installed in the tapped holes on the top of the flanges. Do not discard the bolts as they must be reinstalled once the lifting operation is complete to prevent corrosion of the tapped holes.
3. Make sure the tapped holes on the meter are clean and free of debris before installing the hoist rings.
4. Use only the safety engineered swivel hoist rings that are rated for lifting the meter. Do not use any other type of hoist rings with the same screw size or heavy duty hoist rings. The meter tapping and counter bore size are suitable only for the hoist rings specified by Daniel.
5. When installing a hoist ring, make sure the base surface of the hoist ring fully contacts the machined flat surface of the tapped hole. If the two surfaces do not come in contact then the hoist ring will not hold its full rated load. Torque the hoist ring attachment bolts to the limit indicated on the hoist rings.
6. After installation of the hoist rings, always check that the ring rotates and pivots freely in all directions.
7. NEVER attempt to lift the meter using only one hoist ring.



8. Always use separate slings for each hoist ring. NEVER reeve one sling through both hoist rings. The slings must be of equal length. Each sling must have a load rating that equals or exceeds the hoist ring load rating. The angle between the two slings going to the hoist rings must never exceed 90 degrees or the load rating of the hoist rings will be exceeded.

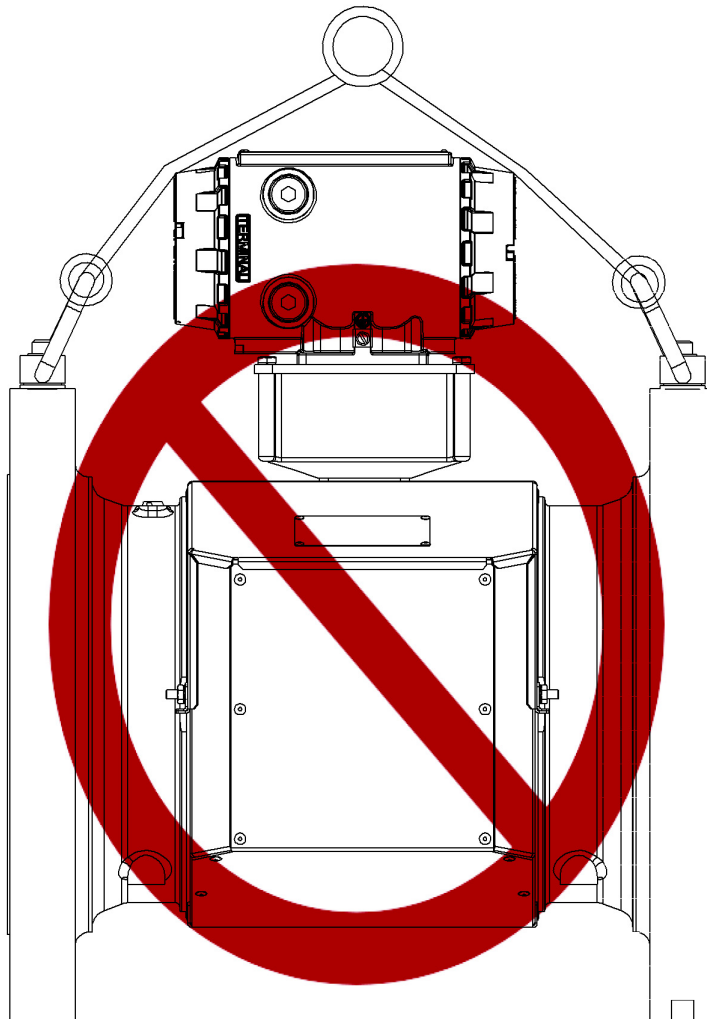
**Figure 2-9 90 Degree angle between slings**



9. **Direct mount option:** NEVER allow the slings to contact the electronics enclosure. Damage to the enclosure may occur. Use a spreader bar with the slings to prevent contact with the electronics enclosure and the base enclosure (see Figure 2-11). If the slings do come in contact with the electronic enclosure then remove the four bolts holding the enclosure to its base and temporarily remove the head from the meter during the lifting operation. You will need to unplug the cable on the Acquisition Module. Two screws hold this cable in place. Once the lifting operation is complete, reattach and secure the electronics cable on the Acquisition Module, return the electronics enclosure to its original position, replace the bolts, and secure the enclosure in place.

Lifting the meter with the upper enclosure installed but without the bolts installed, may cause the electronics to fall and cause personal injury or equipment damage.

**Figure 2-10 Sling contacting electronics enclosure**



10. **Remote mount option:** Always use separate slings for each hoist ring. NEVER reeve one sling through both hoist rings. The slings must be of equal length. Each sling must have a load rating that equals or exceeds the hoist ring load rating. The angle between the two slings going to the hoist rings must never exceed 90 degrees or the load rating of the hoist rings will be exceeded.

### CAUTION

**DO NOT DRAG THE TRANSMITTER ELECTRONICS ENCLOSURE DURING LIFTING OPERATIONS.**

**Support the transmitter electronics while lifting the meter body.**

Failure to do so may r cause damage to the equipment.

### NOTICE

**REMOVE CONDUIT TIE WRAPS FROM THE JUNCTION BOX**

**Conduit tie wraps must be removed prior to powering the meter.**

Tie wraps placed on the junction box conduit for protection during shipping must be removed before the meter is powered.

11. NEVER apply shock loads to the meter. Always lift the meter gradually. If shock loading ever occurs, the hoist ring must be inspected per manufacturer's recommendations prior to be placed in any further service. If a proper inspection cannot be performed, discard the hoist ring.
12. NEVER lift with any device, such as hooks, chains, or cables that could create side pulls that could damage the ring of the hoist ring.
13. NEVER lift more than the ultrasonic meter assembly including electronics and transducers with the hoist rings. The only exception is that it is safe to lift the meter with one ASME B16.5 or ASME B16.47 blind flange bolted to each end flange of the meter. NEVER use the hoist rings on the meter to lift other components such as meter tubes, piping or fittings attached to the meter. Doing so will exceed the load rating of the hoist rings.
14. Remove the hoist rings from the meter after lifting is completed and store them in an appropriate case or container per their manufacturer's recommendation.
15. Apply heavy lubricant or anti-seize to the threads of the plug bolts and reinstall the plug bolts to keep the tapped holes free of debris and to prevent corrosion.

## How to obtain safety engineered swivel hoist rings

A list of approved manufacturers of safety engineered hoist rings is below:

- American Drill Bushing Company([www.americandrillbushing.com](http://www.americandrillbushing.com))
- Carr Lane Manufacturing Company ([www.carrlane.com](http://www.carrlane.com))

Select an approved supplier from the list below. These vendors can supply the safety-engineered hoist rings. This is not intended to be a complete list.

- Fastenal ([www.fastenal.com](http://www.fastenal.com))
- Reid Tools ([www.reidtool.com](http://www.reidtool.com))

The appropriate hoist rings can also be purchased directly from Daniel. The following table provides part numbers for reference:

**Table 2-3 Hoist ring part number lookup table**

Daniel part number <sup>1</sup>	Hoist ring thread size & load rating <sup>1</sup>	American Drill Bushing Co. P/N <sup>1</sup>	Carr Lane Manufacturing Co. P/N <sup>1</sup>
1-504-90-091	3/8"-16UNC, 1000 lb.	23053	CL-1000-SHR-1
1-504-90-092	1/2"-13UNC, 2500 lb	23301	CL-23301-SHR-1
1-504-90-093	3/4"-10UNC, 5000 lb.	23007	CL-5000-SHR-1
1-504-90-094	1"-8UNC, 10000 lb.	23105	CL-10000-SHR-1
1-504-90-095	1-1/2"-6UNC, 24000 lb.	23202	CL-24000-SHR-1

1. Note: The part numbers include only one hoist ring. Two hoist rings are required per meter.

## What size safety engineered swivel hoist ring do you need?

To determine the size of the hoist rings required for your meter, use the appropriate table below for Liquid Ultrasonic Meters (see Table 2-3). Look down the column that matches the ANSI rating of your meter. Find the row that contains your meter size. Follow the row to the end to find the appropriate hoist ring part number.

**Table 2-4 Hoist ring lookup table for Daniel Model 3812 Liquid Ultrasonic Flow Meters**

ANSI 150	ANSI 300	Daniel Part Number
4"to 10"	4" to 10"	1-504-90-091

## 2.3.2 Appropriately rated lifting slings

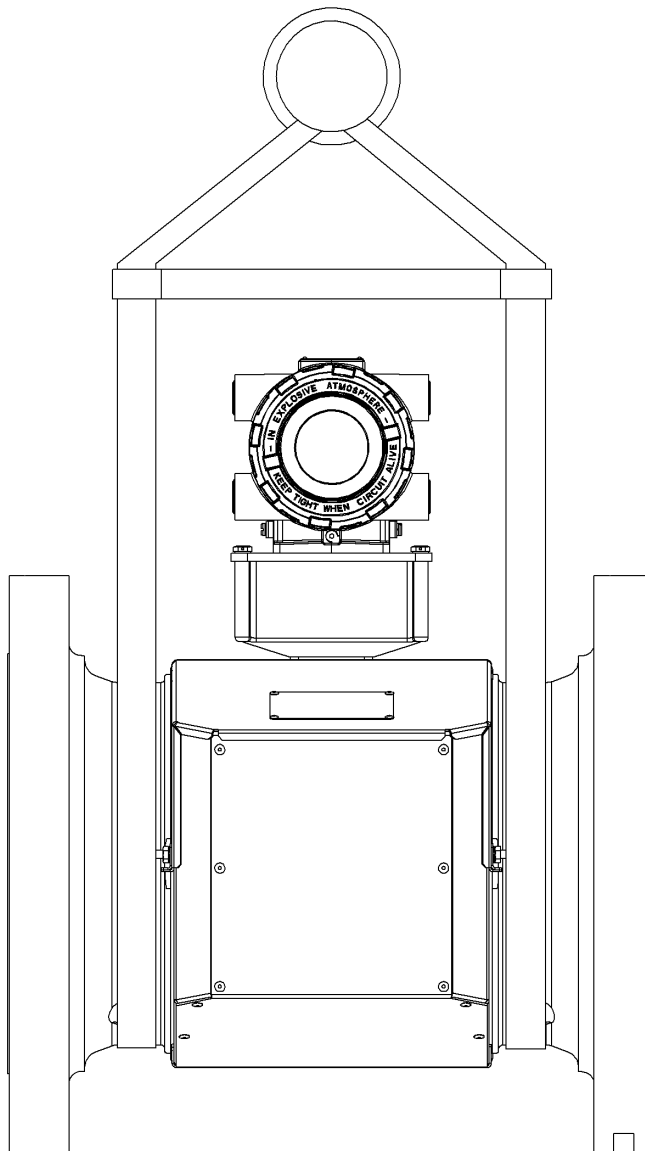
The following instructions are intended to provide general guidelines for proper lifting slings of the Daniel 3812 Ultrasonic meter by itself. These instructions are intended to be followed in addition to your company's standards or the DOE-STD-1090-2004 Hoisting and Rigging standard if such company standards do not exist.

### **Safety precautions using appropriate rated lifting slings**

1. Meters must only be lifted by personnel properly trained in the safe practices of rigging and lifting.
2. **NEVER** attempt to lift the meter by wrapping slings around the electronics enclosure.

3. **NEVER** attempt to lift the meter using only one sling around the meter. Always use two slings wrapped around each end of the body as shown below. A choker style sling is recommended using a spreader bar.

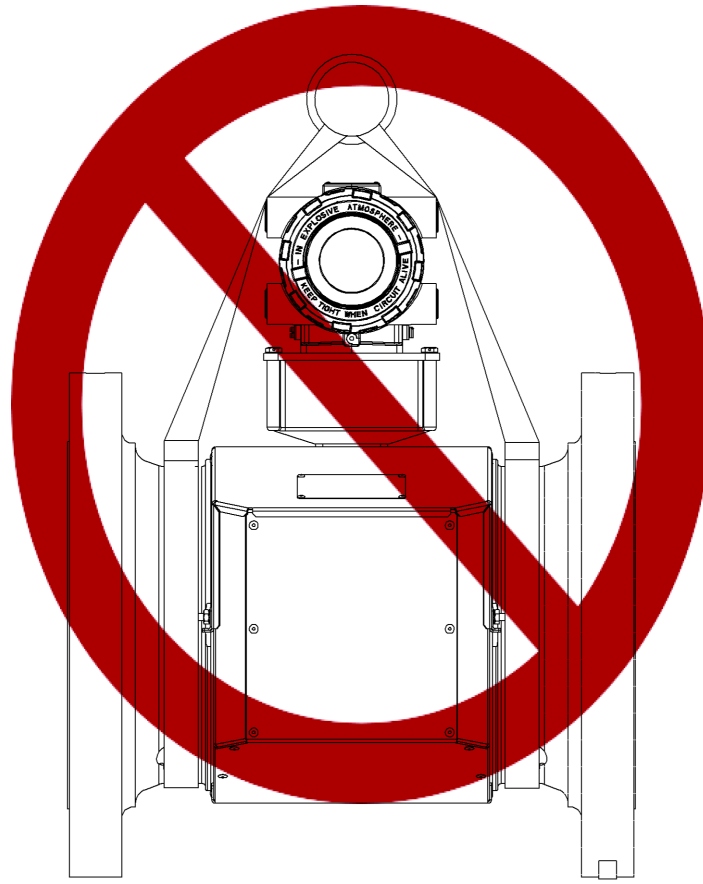
**Figure 2-11 Correct sling attachment**



4. Visually inspect the slings prior to use for any signs of abrasion or other damage. Refer to the sling manufacturer's procedures for proper inspection of the particular sling you are using.
5. Only use slings with ratings that exceed the weight to be lifted. Reference your company's standards for safety factors that must be included when calculating the load rating.

6. **NEVER** allow the slings to contact the electronics enclosure or the transducer shrouds. Damage to the meter may occur. If the slings do come in contact with the electronics or the shroud, temporarily remove the head from the meter during the lifting operation (remove the four bolts holding the enclosure to its base and unplug the cable from the Acquisition Module. Two screws hold this cable in place.) Use a spreader-bar on the sling to prevent contact with the electronics or the transducer shroud.
7. Once the lifting operation is complete, reattach and secure the electronics cable to J3 on the Acquisition Module, return the electronics enclosure to its original position, replace the bolts, and secure the enclosure in place. Lifting the meter with the upper enclosure installed but with out the bolts installed, may cause the electronics to fall and cause personal injury or electronics damage.

Figure 2-12 Incorrect sling attachment



8. **NEVER** apply shock loads to the meter. Always lift the meter gradually. If shock loading ever occurs, the slings must be inspected per manufacturer's procedures prior to being placed in any further service.



## 2.4 Mounting requirements in heated or cooled pipelines

The ambient operating temperature of the 3812 Liquid Allocation electronics (i.e. Flameproof enclosure and Intrinsically safe base enclosure) is -40 °C to +60 °C (-40 °F to +140 °F).

If the meter is installed into a pipeline which is heated or cooled outside this temperature range it is necessary to remove the Transmitter Electronics enclosure from the meter body (i.e. Spool piece acting as process fluid conduit) and mount it next to the meter body on a pipe stand or other rigid structure. The process temperature must also not exceed the operating temperature range of the transducers. LT-10 and LT-11 operating temperature range -50 °C to 135 °C (-58 °F to +275 °F) with NBR o-rings and operating temperature range -40 °C to +150 °C (-40 °F to +302 °F with FKM o-rings).

### CAUTION

#### **SURFACE TEMPERATURE HAZARD.**

**The meter body and piping may be extremely hot or cold.**

Wear appropriate personal protective equipment when coming in contact with the meter. Failure to do so may result in injury.



## Section 3: Electrical installation

### 3.1 Cable length TTL mode

The maximum cable length is 2000 feet when the “TTL” mode is selected.

### 3.2 Cable length Open Collector mode

For the “open collector” mode, the maximum cable length depends on the cable parameters, pull-up resistance used, the maximum frequency to output, and frequency input parameters being driven. The following table provides estimated cable lengths for different pull-up resistor values and different Max Frequency settings in the meter using the following cable parameters. The table also provides an estimated cable voltage drop which indicates how much voltage will be across the cabling and effectively indicates to what voltage level the frequency input can be pulled down to by the frequency output.

If the voltage drop is higher than the voltage required for the frequency input to see a low state, then the configuration will most likely not work for your system. Performance of frequency outputs will vary from this table with setup and frequency input being driven.

**Table 3-1 Configurations for open collector frequency outputs**

Cable	Cable resistance	Cable	Pull-up resistance	Total	Maximum frequency	Sink	Cable voltage drop
Length	(2 Conductors)	Capacitance	Resistance	Resistance	Frequency	Current	(2 Conductors)
(x1000ft)	$\Omega$	nF	$\Omega$	$\Omega$	(Hz)	(A)	VDC
0.5	16.8	10.00	1000	1016.8	5000	0.024	0.397
1	33.6	20.00	1000	1033.6	1000	0.023	0.780
2	67.2	40.00	1000	1067.2	1000	0.022	1.511
4	134.4	80.00	1000	1134.4	1000	0.021	2.843
0.5	16.8	10.00	500	516.8	5000	0.046	0.780
1	33.6	20.00	500	533.6	5000	0.045	1.511
1.7	57.12	34.00	500	557.12	5000	0.043	2.461
6.5	218.4	130.00	500	718.4	1000	0.033	7.296

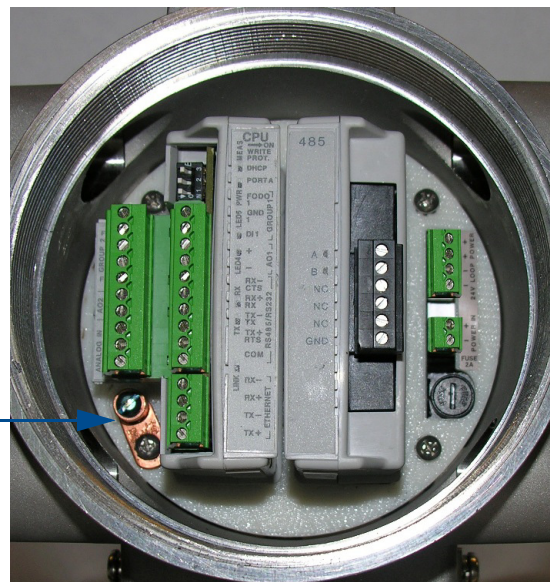
The 22 AWG wire characteristics are as follows:

- Capacitance = 20 pF/ft or 20 nF/1000 ft (between two wires)
- Resistance = 0.0168 Ohms/ft or 16.8 Ohms/1000 ft
- Pull-up voltage is 24 VDC

Daniel 3812 Liquid Ultrasonic Flow Meter electronics should be internally grounded for intrinsically safe operations. Connect a wire to the chassis ground lug installed inside the Transmitter Electronics Enclosure as the primary ground. A secondary ground is located outside of the Transmitter Electronics Enclosure (see [Figure 3-2](#)). Digital grounds should never be connected to chassis ground.

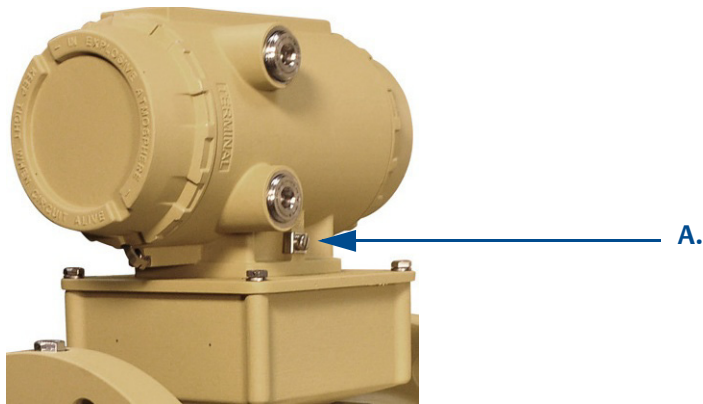
The internal grounding terminal shall be used as the primary equipment ground. The external terminal is only a supplemental bonding connection where local authorities permit or require such a connection.

A. 



### A. Transmitter Electronics Enclosure internal ground lug

Figure 3-2 External ground lug



A. External ground lug

## 3.4 Conduit seals

Daniel 3812 Liquid Ultrasonic Flow Meters require conduit seals for installations in hazardous environments. Adhere to safety instructions to protect personnel and equipment.

### **⚠ WARNING**

#### **HAZARDOUS VOLTAGE INSIDE**

**Do not open the Transmitter Electronics Enclosure when an explosive gas atmosphere is present. Disconnect equipment from supply circuit before opening.**

Failure to remove power may result in serious injury or death.

### **⚠ WARNING**

#### **DEATH OR SERIOUS INJURY MAY OCCUR**

**Explosion hazard. Substitution of components may impair intrinsic safety.**

Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.

### 3.4.1 Startup for systems using explosion-proof conduit

1. Assemble flexible conduit (recommended by Daniel) to the Transmitter Electronics Enclosure. A conduit seal fitting is required within 18 inches (457 mm) of the enclosure.
2. Check to make certain that all power to field wiring is turned **OFF**.

#### **WARNING**

##### **HAZARDOUS VOLTAGE INSIDE**

**Do not open the Transmitter Electronics Enclosure when an explosive gas atmosphere is present. Disconnect equipment from supply circuit before opening the enclosure.**

Failure to remove power may result in serious injury or death.

3. Remove the end cap nearest the conduit entry to gain access to the transmitter electronics.
4. Pull the wires.
5. Complete the field connection wiring.
6. Apply electrical power to the system and verify the field connections are working correctly. Allow the system to run for the time specified by the customer (approximately one week) and an electrician has fully tested the connections. After the Acceptance Test is witnessed and approved, seal the conduit.
7. Power down the system and apply the sealing compound to the conduit and allow the compound to set in accordance with manufacturer specifications.
8. Install the security latches and wire seals on the Transmitter Electronics Enclosure end caps ([see Section 3.7.1](#)).
9. If required, install the wire seals on the Base Enclosure hex head bolts and on the Shroud covering the meter body ([see Section 3.7.2](#)).
10. Install the security wire seals on the shrouds covering the transducers and cables. Refer to the section appropriate for your meter design:
  - [Section 3.7.4 “Bolted band shroud security seals”](#)
  - [Section 3.7.5 “Clamped band shroud security seals”](#)
  - [Section 3.7.6 “Split shroud security seals”](#)
  - [Section 3.7.7 “Latched band shroud security seals”](#)
11. Re-apply electrical power to the system.
12. Set or configure the meter parameters using Daniel MeterLink. For additional installation information refer to the system wiring diagram ([see Appendix A](#)), *Daniel MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (P/N 3-9000-763) and use Daniel MeterLink Field Setup Wizard to complete the configuration.

## 3.4.2 Startup for systems that use flame-proof cable

### **⚠ WARNING**

#### **HAZARDOUS VOLTAGE INSIDE**

**Do not open the Transmitter Electronics Enclosure when an explosive gas atmosphere is present. Disconnect equipment from supply circuit before opening.**

Failure to remove power may result in serious injury or death.

1. Check to make certain that all field wiring power is turned **OFF**.
2. Remove the end cap nearest the cable entries to gain access to the transmitter electronics.
3. Install the cable and cable gland.
4. Complete the field connection wiring.
5. Connect a flow computer to the communications line on the Daniel3812 Liquid Ultrasonic Flow Meter.
6. Apply electrical power to the system to ensure the field connections are working correctly. Allow the system to run for the time specified by the customer (usually one week) and an electrician has fully tested the connections. After the Acceptance Test is witnessed and approved, seal the conduit.
7. Power down the system and apply the sealing compound to the conduit and allow to set in accordance with manufacturer specifications.
8. Install the security latches and wire seals on the Transmitter Electronics Enclosure end caps ([see Section 3.7.1](#))
9. Install the wire seals on the Base Enclosure hex head bolts and on the Shroud covering the meter body ([see Section 3.7.2](#)).
10. Install the security wire seals on the shrouds covering the transducers and cables. Refer to the section appropriate for your meter design:
  - [Section 3.7.4 “Bolted band shroud security seals”](#)
  - [Section 3.7.5 “Clamped band shroud security seals”](#)
  - [Section 3.7.6 “Split shroud security seals”](#)
  - [Section 3.7.7 “Latched band shroud security seals”](#)
11. Connect electrical power to the system.
12. Set or configure the meter using Daniel MeterLink. For additional installation information refer to the system wiring diagram ([see Appendix A](#)), Daniel MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual (P/N 3-9000-763) and use Daniel MeterLink Field Setup Wizard to complete the meter configuration.

## 3.5 Wiring and I/O

Daniel MeterLink uses the TCP/IP protocol to communicate with the 960-24™ MSTs electronics instead of Modbus ASCII or RTU. The TCP/IP protocol only works across either Ethernet, RS-485 full duplex (i.e., 4-wire), or RS-232. Daniel MeterLink can communicate with multiple meters if they are multi-dropped using 4-wire full duplex RS-485 mode. The meter electronics are HART capable and provide communication flexibility with Daniel 3812 Liquid Ultrasonic Flow Meters.

The HART® output provides communication with other field devices (e.g., 475/375 Field Communicator and AMS™ Device Manager software) and ultimately, communicates key diagnostic information through PlantWeb® architecture.

### **NOTICE**

If not using Ethernet, a full duplex serial connection is necessary for Daniel MeterLink to communicate with a Daniel 3812 Liquid Ultrasonic Flow Meter.

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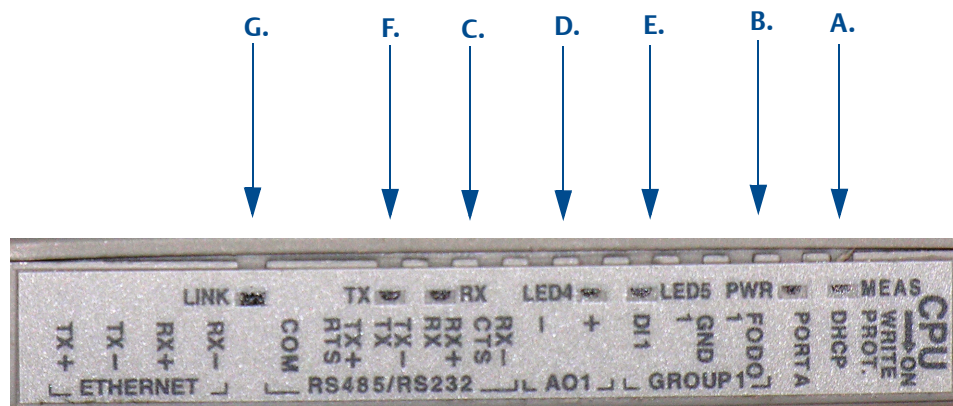
The meter's electronics auto-detects the protocol used and automatically switches between TCP/IP, Modbus ASCII, and Modbus RTU so it is not necessary to make any meter configuration changes to change the protocol.



### 3.5.1 CPU Module labeling and LED indicators

The meter's metrology mode and the status of the data transfer from the Acquisition Module to the CPU Module is indicated via light-emitting diode (LED) status indicators. The Write PROT. switch protects the meter's configuration,

Figure 3-3 CPU Module labeling and LED indicators



- A. Acquisition/Measurement mode
- B. Power
- C. RX (RS-485/RS-232) - receiving data
- D. LED 4 - not used
- E. LED 5 - not used
- F. TX (RS-485/RS-232) - transmitting data
- G. Link (Eth1 Link) - user Ethernet connection

Table 3-2 CPU Module labeling and LED functions

CPU Module switch	Function	Switch position indicator or LED
WRITE PROT.	<ul style="list-style-type: none"> <li>Write-protect mode - with switch in the ON position (default setting) protects configuration and firmware overwrites.</li> <li>To write configuration changes or download firmware to the meter change the switch to the OFF position</li> </ul>	Switch position <ul style="list-style-type: none"> <li><b>ON</b> - (default setting) enables write-protection of the configuration and firmware</li> <li><b>OFF</b> - enables writing configuration changes or downloading firmware</li> </ul>
DHCP	<ul style="list-style-type: none"> <li>Dynamic Host Protocol Server - enables you to communicate with a Daniel meter that is not connected to a network.</li> <li>When the CPU Module switch is in the ON position, the meter is enabled to act as a DHCP server for a single DHCP client connected to the Ethernet port using a crossover cable. This should be used for peer to peer connections only.</li> <li>When the connection is made, select to use the Meter Name in the meter instead of the Meter Directory Name in order to keep all log files and configurations separate from each meter.</li> </ul>	Switch position <ul style="list-style-type: none"> <li><b>ON</b> - the meter is enabled to act as a DHCP server for a single DHCP client</li> <li><b>OFF</b> - disables the DHCP server</li> </ul>
PORT A	<ul style="list-style-type: none"> <li>PORT A override - RS-232 serves as an override during meter commissioning to establish communications and in the event the user cannot communicate with the meter due to an inadvertent communication configuration change. The override period is for two minutes</li> <li>Supports:               <ul style="list-style-type: none"> <li>auto-detected ASCII (Start bit 1, Data Bit 7, Parity Odd/Even, Stop Bit 1)</li> <li>RTU (Start Bit 1, Data Bit 8, Parity none, Stop Bit 1).</li> <li>Modbus protocols</li> </ul> </li> <li>RS-232 Baud rate=19,200</li> <li>Modbus ID=32</li> </ul>	Switch position <ul style="list-style-type: none"> <li><b>ON</b> - enables RS-232 PORT A override</li> <li><b>OFF</b> - (default setting) disables RS-232 PORT A</li> </ul>
MEAS	System color indicates metrology mode <ul style="list-style-type: none"> <li>Acquisition mode</li> <li>Measurement mode</li> </ul>	LED status <ul style="list-style-type: none"> <li>Red flashing LED</li> <li>Solid red the Acquisition Module not communicating with the CPU Module</li> <li>Green flashing LED</li> </ul>
PWR	<ul style="list-style-type: none"> <li>3.3V Power Indicator</li> </ul>	<ul style="list-style-type: none"> <li>Solid Green</li> </ul>
LED 4	<ul style="list-style-type: none"> <li>Not used</li> </ul>	
LED 5	<ul style="list-style-type: none"> <li>Not used</li> </ul>	
RX	<ul style="list-style-type: none"> <li>RX signal (Port A for RS485 or RS232 communication) receiving data</li> </ul>	<ul style="list-style-type: none"> <li>Flashing green (when receiving data)</li> </ul>
TX	<ul style="list-style-type: none"> <li>TX signal (Port A for RS485 or RS232 communication) transmitting data</li> </ul>	<ul style="list-style-type: none"> <li>Flashing green (when transmitting data)</li> </ul>
LINK	<ul style="list-style-type: none"> <li>ETH1Link user Ethernet connection</li> </ul>	<ul style="list-style-type: none"> <li>Solid green</li> </ul>

## Ethernet communications

The Ethernet port IP address, subnet mask, and gateway address are software-configurable. In addition, a meter can be configured to act as a DHCP (Dynamic Host Configuration Protocol) server to assign an IP address to a PC or laptop running Daniel MeterLink. The DHCP server facility is not intended to act as a general purpose DHCP server for a wider network. To this end, no user control is provided over the class or range of IP addresses the unit provides. A standard twisted pair (Cat-5) cable should be used for Ethernet wiring.

It is strongly recommended that the meter be configured using an independent (off-network) single host. After configuration of the meter, the DHCP option must be turned off if used on a LAN/WAN.

### CAUTION

#### RESTRICT ETHERNET AND SERIAL CONNECTIVITY USAGE

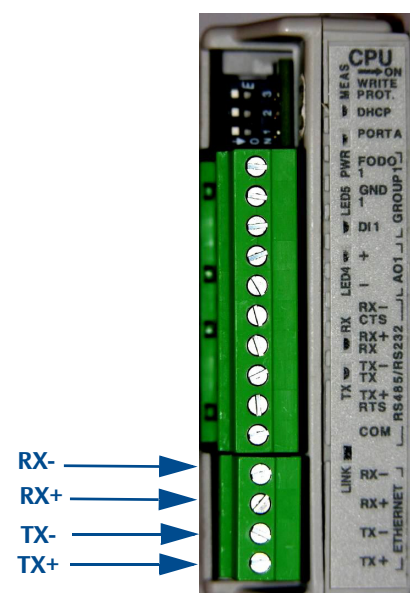
Failure to restrict Ethernet and communication access to the Daniel 3812 Liquid Ultrasonic Flow Meter can result in, among other things, unauthorized access, system corruption, and/or data loss.

User is responsible for ensuring that physical access and Ethernet or electronic access to the Daniel 3812 Liquid Ultrasonic Flow Meter is appropriately controlled and any necessary security precautions, such as, establishing a firewall, setting password permissions and/or implementing security levels.

Use ethernet cable (Daniel P/N 3-3400-079) to connect the PC to the meter.

**Table 3-3 Ethernet cable to PC communication**

Ethernet communication	
Wire color	CPU
White w/Orange Stripe	TX+
Orange w/White Stripe	TX -
White w/Green Stripe	RX+
Green w/White Stripe	RX -



A DIN 41612 48-pin connector is the interface from the CPU Module to the Field Connection Board (male end located on the back of the Field Connection Board).

## Serial connections

Use serial cable (Daniel P/N 3-2500-401) to connect to a PC running Daniel MeterLink. The cable is designed for RS-232 communications which is the serial Port A default configuration (see [Appendix A](#) field wiring diagram, Daniel Drawing DMC - 005558). The DB-9 end of the cable plugs directly into the PC running Daniel MeterLink. The three wires on the other end of the cable connect to the CPU Module. The RED wire goes to RX, the WHITE wire goes to TX, and the BLACK wire goes to COM for the RS-485/RS-232 ([Table 3-4](#) for Port A wiring).

When Belden wire No. 9940 or equivalent is used, the maximum cable length for RS-232 communications at 9600 bps is 88.3 meters (250 ft.) and the maximum cable length for RS-485 communication at 57600 bps is 600 meters (1970 ft.).

Port A supports a special override mode which forces the port to use known communication values (19200 baud, address 32, RS-232). Note that the protocol is auto-detected. This mode is expected to be used during meter commissioning (to establish initial communication) and in the event that the user cannot communicate with the meter (possibly due to an inadvertent communication configuration change). Alternately, when using Daniel MeterLink™ with an Ethernet port, use Ethernet cable (Daniel P/N 3-3400-079) to connect the PC.

**Table 3-4 Serial Port A parameters**

Port/Communication	Description	Common features
Port A (Standard) <ul style="list-style-type: none"> <li>RS-232</li> <li>RS-485 Half Duplex</li> <li>RS-485 Full Duplex</li> </ul>	<ul style="list-style-type: none"> <li>Typically used for general communications with a flow computer, RTU (Modbus slave) and radios.</li> <li>Special override mode to force port configuration to known settings.</li> <li>Supports RTS/CTS handshaking with software-configurable RTS on/off delay times.</li> <li>Factory default is RS-232, Address 32, 19200 baud.</li> </ul>	<ul style="list-style-type: none"> <li>Communications via Daniel MeterLink using RS-232 or RS-485 Full Duplex</li> <li>Software configurable Modbus Address (1-247)</li> <li>Auto-detects TCP/IP and ASCII or RTU Protocol <ul style="list-style-type: none"> <li>ASCII Protocol: <ul style="list-style-type: none"> <li>Start Bits = 1, Data Bits=7<sup>1</sup></li> <li>Parity: odd or even 1, Stop Bits =1<sup>1</sup></li> <li>Baud Rates: 1200, 2400, 9600, 19200, 38400, 57600, 115000 bps</li> </ul> </li> <li>RTU Protocol: <ul style="list-style-type: none"> <li>Start Bits = 1, Data Bits=8<sup>1</sup></li> <li>Parity: none, Stop Bits = 1<sup>1</sup></li> <li>Baud Rates: 1200, 2400, 9600, 19200, 38400, 57600, 115000 bps</li> </ul> </li> </ul> </li> </ul>
Ethernet	<ul style="list-style-type: none"> <li>Preferred port for diagnostic communication via Daniel MeterLink</li> <li>10 Mbps/100 Mbps</li> </ul>	<ul style="list-style-type: none"> <li>Modbus TCP/IP</li> </ul>

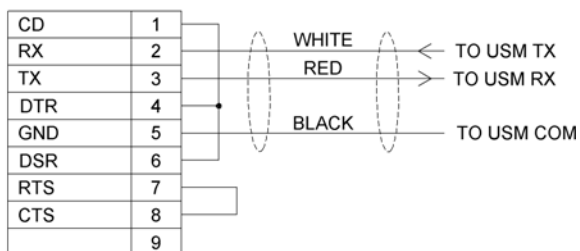
<sup>1</sup>. Denotes auto-detected protocols.

## NOTICE

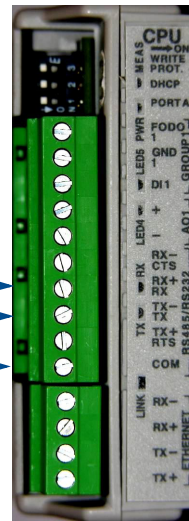
If not using Ethernet, a full duplex serial connection is necessary for Daniel MeterLink to communicate with a Daniel 3812 Liquid Ultrasonic Flow Meter.

Figure 3-4 PC to meter serial connection wiring

DB-9 Connector Female



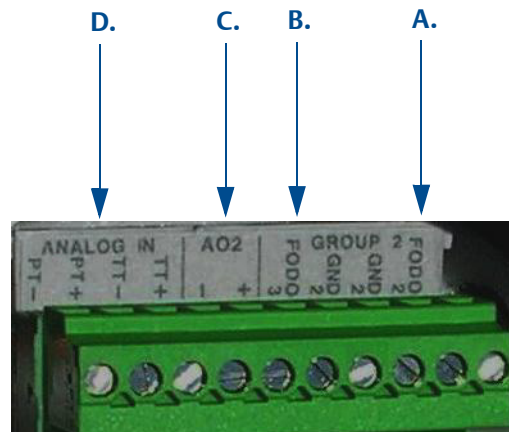
RX  
TX  
COM



## 3.6 I/O connections

The meter provides the I/O connections on the CPU Module.

Figure 3-5 CPU Module I/O connections



- A. Frequency/Digital Output 2
- B. Frequency/Digital Output 3
- C. Analog Output 2, 4-20mA output
- D. Analog Input - HART temperature and pressure connections

### 3.6.1 Frequency/Digital outputs

The meter has three user-configurable selections for configuring either a Frequency output or Digital output (FODO).

- FODO1 (four possible parameter configurations)
- FODO2 (eight possible parameter configurations)
- FODO3 (eight possible parameter configurations)

#### Frequency or Digital Outputs (FODO 1) source

- FO1A, DO1A, FO1B, DO1B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1 B Phase
- Digital output 1A is based on Digital output1A content (Frequency1A Validity and Flow Direction)

#### Frequency or Digital Outputs (FODO 2) source

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1 B Phase
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 2B is based on frequency content and Frequency 2B Phase
- Digital output 1A is based on Digital output1A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output2A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output 2A content (Frequency 2A Validity and Flow Direction)
- Digital output 2B is based on Digital output 2B content (Frequency 2B Validity and Flow Direction)

### Frequency or Digital Outputs (FODO 3) source

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1B Phase
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 2B is based on frequency content and Frequency 2B Phase
- Digital output 1A is based on Digital output1A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output2A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output 2A content (Frequency 2A Validity and Flow Direction)
- Digital output 2B is based on Digital output 2B content (Frequency 2B Validity and Flow Direction)

### Mode options

- Open Collector (requires external excitation supply voltage and pull-up resistor)
- TTL (internally powered by the meter 0-5 VDC signal)

### Channel B Phase options:

- Lag forward, Lead reverse (Phase B lags Phase A while reporting forward flow, leads Phase A while reporting reverse flow)
- Lead forward, Lag reverse (Phase B leads Phase A while reporting forward flow, lags Phase A while reporting reverse flow)

### Phase A and Phase B output (based on flow direction)

- Reverse flow - output only reports flow in the reverse direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Forward flow - output only reports flow in the forward direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Absolute - output reports flow in both directions. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Bidirectional - output reports flow on Phase A only in the forward direction and on Phase B only in the reverse direction.

## Maximum frequency for the frequency outputs

- 1000Hz
- 5000Hz

**Table 3-5 Frequency/Digital Outputs possible configurations**

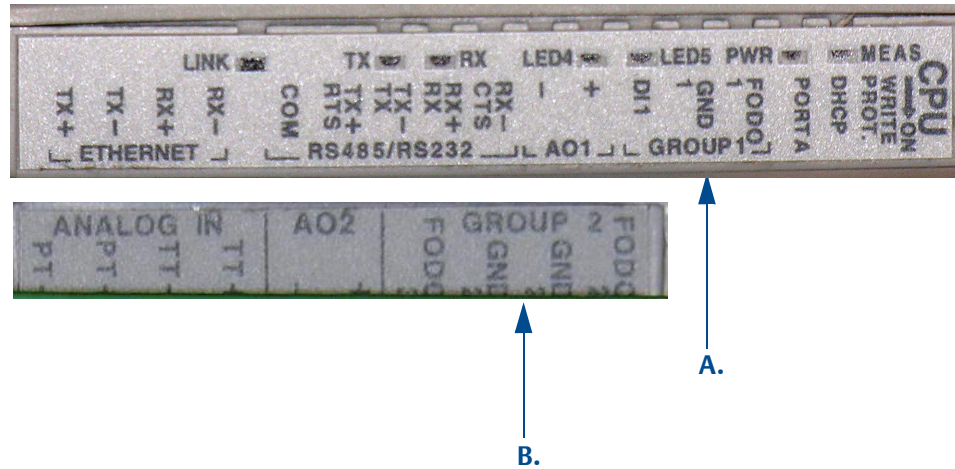
Frequency/Digital output		Source configuration
Frequency /Digital Output 1 <sup>1</sup>	<ul style="list-style-type: none"> <li>• Frequency output 1A</li> <li>• Frequency output 1B</li> <li>• Digital output 1A</li> <li>• Digital output 1B</li> </ul>	
Frequency /Digital Output 2 <sup>2</sup> or Frequency /Digital Output 3 <sup>2</sup>	<ul style="list-style-type: none"> <li>• Frequency output 1A</li> <li>• Frequency output 1B</li> <li>• Digital output 1A</li> <li>• Digital output 1B</li> <li>• Frequency output 2A</li> <li>• Frequency output 2B</li> <li>• Digital output 2A</li> <li>• Digital output 2B</li> </ul>	

1. Solid blue line denotes valid selection for Frequency/Digital Output 1.
2. Black dashed -line denotes valid selections for Frequency/Digital Output 2 and Frequency/Digital Output 3.



Output for FODO1 and Digital Output1 (Group 1 on the CPU Module) share a common ground and have 50V isolation. FODO2 and FODO3 (Group 2 on the CPU Module) share a common ground and have 50V isolation. This allows an output to be connected to a different flow computer. The outputs are opto-isolated from the CPU Module and have a withstand voltage of at least 500V rms dielectric.

**Figure 3-6 CPU Module - Frequency/Digital outputs common ground**



- A. FODO1 and Digital input1 - shared common ground (Group 1)
- B. FODO2 and FODO3 - shared common ground (Group 2)

## 3.6.2 Analog input settings

The 960-24™ MSTs has the capability to sample analog temperature (Analog Input 1) and pressure (Analog Input 2) with 4-20 mA signals. These analog input signals are configured to sink. The two independent analog input circuits are configured for conventional 4-20 mA service. Also, 24VDC isolated power supply connection is provided for an external power source. Refer to the Field wiring diagram (see [Appendix A](#) drawing DMC004936).

## 3.6.3 Analog output settings

The 960-24™ MSTs provides two 4-20 mA analog output signals that are software configurable for either sink or source current (see [Appendix A](#) drawing DMC004936).

Full HART® functionality is provided so that any commercially available HART® transmitter which meets the specifications of the HART® Communications Foundation can be connected to the Daniel 3812 Liquid Ultrasonic Flow Meter.

Analog Output 2 (AO2) is user-configurable as a conventional 4-20 mA output.

## 3.6.4 Digital Input

The Daniel 3812 Liquid Ultrasonic Flow Meter provides one digital input that can be used as a general purpose input or used for synchronizing calibration (for flow calibration gating - contact closure). The meter records the volume seen between switch closures. The polarity of the input is configured as normal or inverted polarity.

- polarity is determined by the `IsDI1ForCalActiveLow` and the gating edge is determined by the `IsDI1ForCalStateGated` (calibrate edge gated or calibrate state gated).
- calibration is started and stopped via an **inactive>active** state change.

The digital input must be configured via the Daniel MeterLink **Tools>Edit/Compare Configuration** page.

## 3.6.5 DHCP server switch settings

The meter can be configured to act as a DHCP server. The DHCP server is enabled/disabled via CPU Module DHCP switch as follows:

**Table 3-6 DHCP server switch settings**

CPU Module switch	DHCP server disabled	DHCP server enabled
DHCP	OFF	ON

## 3.6.6 Configuration protect switch settings

The meter's configuration parameters and firmware can be protected against changes via CPU Module Write PROT. switch as follows:

**Table 3-7 Configuration protect switch settings**

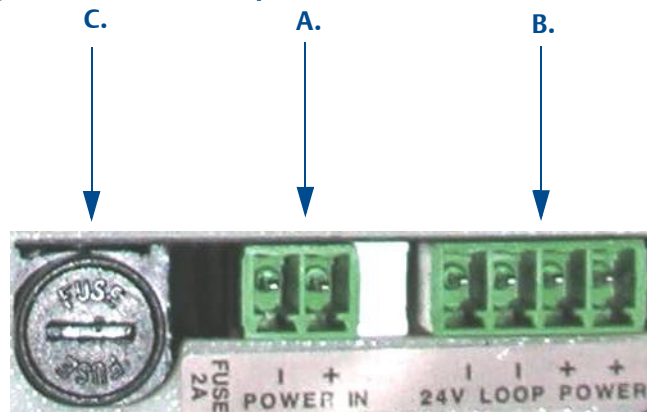
CPU Module switch	Configuration protected	Configuration unprotected
WRITE PROT.	ON (default)	OFF

A complete list of write-protected parameters are in [Appendix A](#).

## 3.6.7 External power source connection and fuse

Located inside the Transmitter Electronics Enclosure is a connector for a user-provided external power source, a 2 Ampere fuse and a 24V loop power connection for ultrasonic meter analog outputs, generator transmitter or pressure transmitter devices. The current is limited to 88mA.

**Figure 3-7 CPU Module power source connections**



- A. Power In connector (main power)
- B. 24V LOOP POWER
- C. 2 Ampere fuse (used for the main power input)

## 3.7 Security seal installation

Security seals protect the integrity of the meter metrology and prevent tampering with transducer assemblies. The following sections detail how to properly seal the Daniel 3812 Liquid Ultrasonic Flow Meter after commissioning. The security seal wires are commercially available.

### **⚠ WARNING**

#### **CUTTING HAZARD**

**Sharp edges may be present on the band shrouds.**

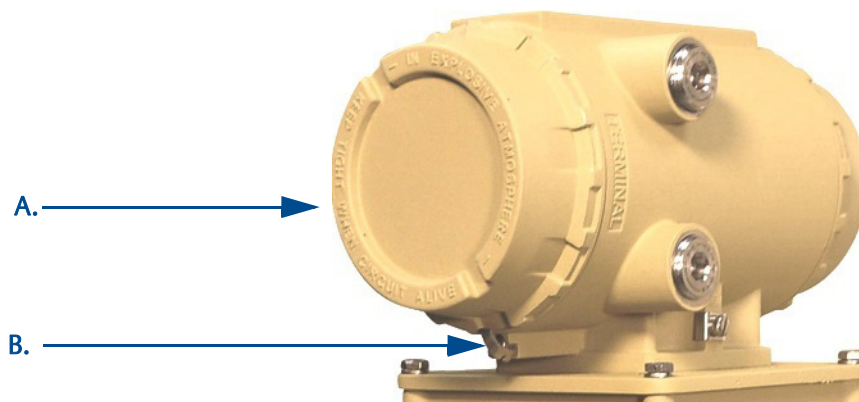
Wear appropriate personal protective equipment when working on the meter. Failure to do so may cause serious injury.

Be sure to set the WRITE PROT. switch on the CPU Module to the ON position prior to sealing the enclosure.

### 3.7.1 Direct or remote mount transmitter electronics enclosure seal

Use the following instructions to install the security seal wires on the Transmitter Electronics Enclosure.

**Figure 3-8 Transmitter electronics enclosure security latch**

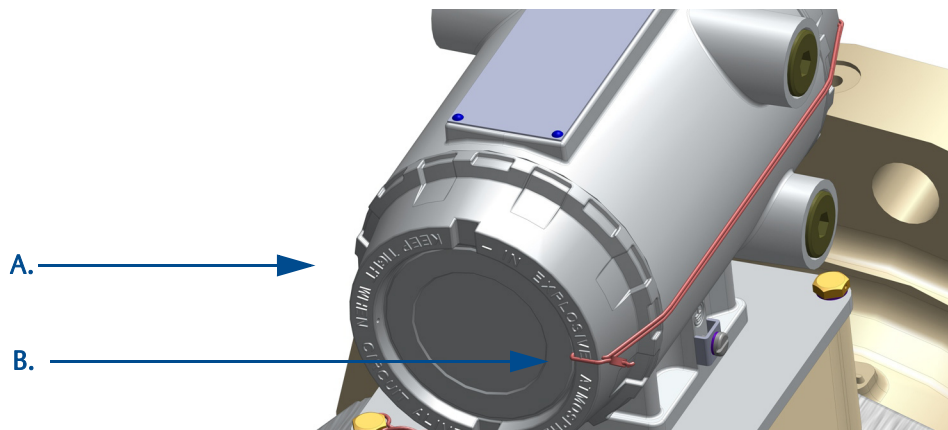


- A. Transmitter Electronics Enclosure end cap
- B. Security latch

## Procedure

1. Rotate the end cap clockwise fully closing and compressing the end cap seal. Install the Security latch using a 3mm Allen wrench.
2. Install the security seal wire into and through one of the two holes in the end cap. Choose holes that minimize counterclockwise rotation of the end cap when the security wire is taut (maximum wire diameter .078 inch; 2.0mm).

**Figure 3-9 Direct or remote mount Transmitter Electronics Enclosure security seals**



- A. Transmitter Electronics Enclosure end cap  
B. Security wire seals

3. Adjust the security wire, removing all slack and thread into the lead seal.
4. Cut wire ends to remove excess wire.
5. This completes the direct or remote Transmitter Electronics Enclosure seal installation procedure.

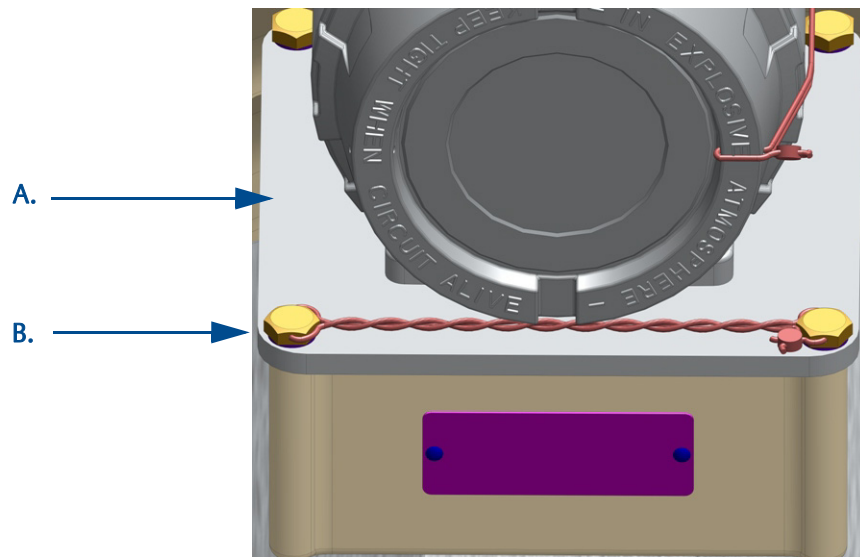
## 3.7.2 Base Enclosure Security Seals

Use the following instructions to install the security seal wire on the Base Enclosure.

### Procedure

1. Install security wire seal into and through two of the four the holes in the socket head screws on the Base Enclosure cover (maximum wire diameter .078 inch; 2.0mm).

**Figure 3-10 Base Enclosure security seals**



- A. Base Enclosure  
B. Security wire seals

2. Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut.
3. Twist and adjust wire removing all slack and seal.
4. Cut wire ends to remove excess wire.
5. This completes Base Enclosure security seal installation procedure.

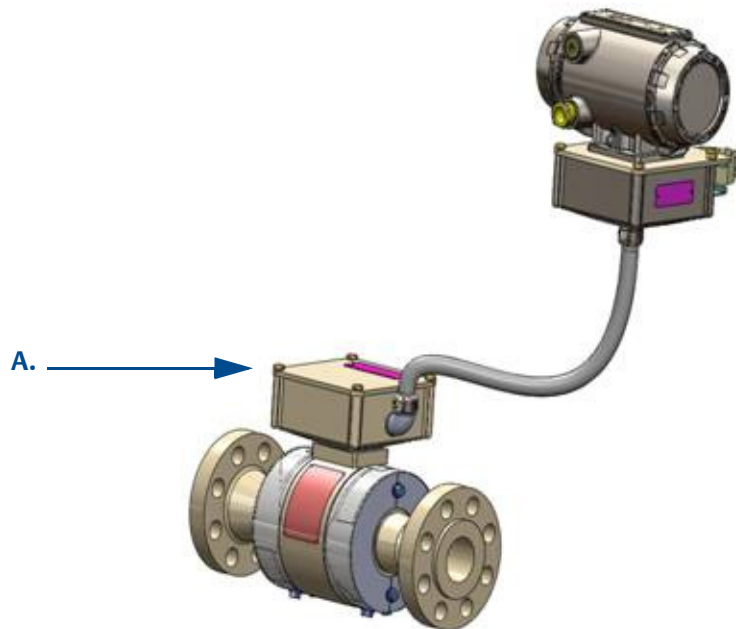
### 3.7.3 Seal the Junction Box remote mount electronics option

Use the following instructions to install the security seal wire on the junction box, if required.

#### Procedure

1. Install security wire seal into and through two of the four the holes in the socket head screws on the Junction Box cover (maximum wire diameter .078 inch; 2.0 mm).

**Figure 3-11 3812 Remote mount transmitter electronics option**



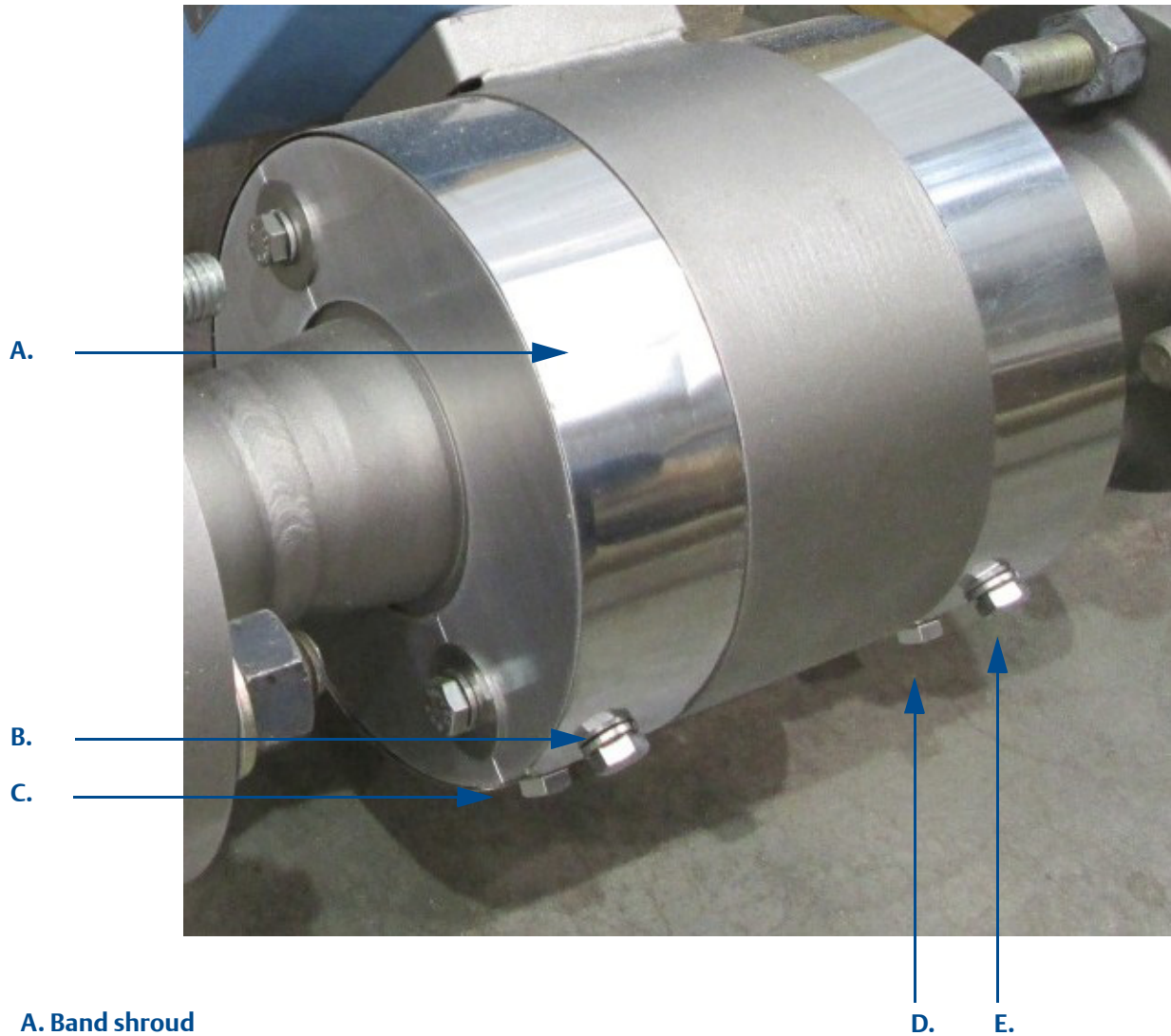
#### A. Junction Box socket head screws

2. Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut.
3. Twist and adjust wire removing all slack and seal.
4. Cut wire ends to remove excess wire.
5. This completes installing security seals on the Junction Box.

### 3.7.4 Bolted band shroud security seals

If required, use the following instructions to install bolted band shrouds security wire seals.

**Figure 3-12 Bolted band shroud security seals - bottom view**



- A. Band shroud
- B. Left front shroud bolt 1/4"- 20
- C. Left back shroud bolt 1/4"- 20
- D. Right back shroud bolt 1/4"- 20
- E. Right front shroud bolt 1/4"- 20



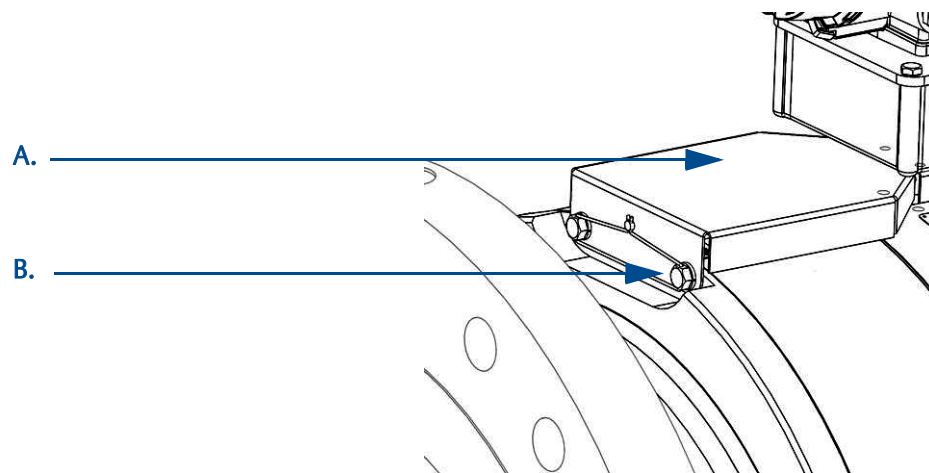
## Procedure

1. Beneath the meter, install the security wires into and through the left front bolt (Item B) and feed through the holes in the right back bolt (Item D).
2. Repeat wire installation through the right front bolt (Item E) to the left rear bolt (Item C) as shown in [Figure 3-12](#). The maximum wire diameter .078 inch; 2.0 mm.
3. Position the wire to prevent counterclockwise rotation of the bolts when the seal wire is taut.
4. Adjust the security wire, removing all slack and thread into the lead seal.
5. Cut wire ends to remove excess wire.
6. This completes the bolted band shroud security seal installation procedure.

### 3.7.5 Clamped band shroud security seals

Use the following instructions to install the security seal wires, if required, on the two top end shrouds covering the worm screw clamps. This procedure applies to clamped band shroud meters.

**Figure 3-13 Clamped shroud security seals**



**A. Top end shroud**  
**B. Security wire seals**

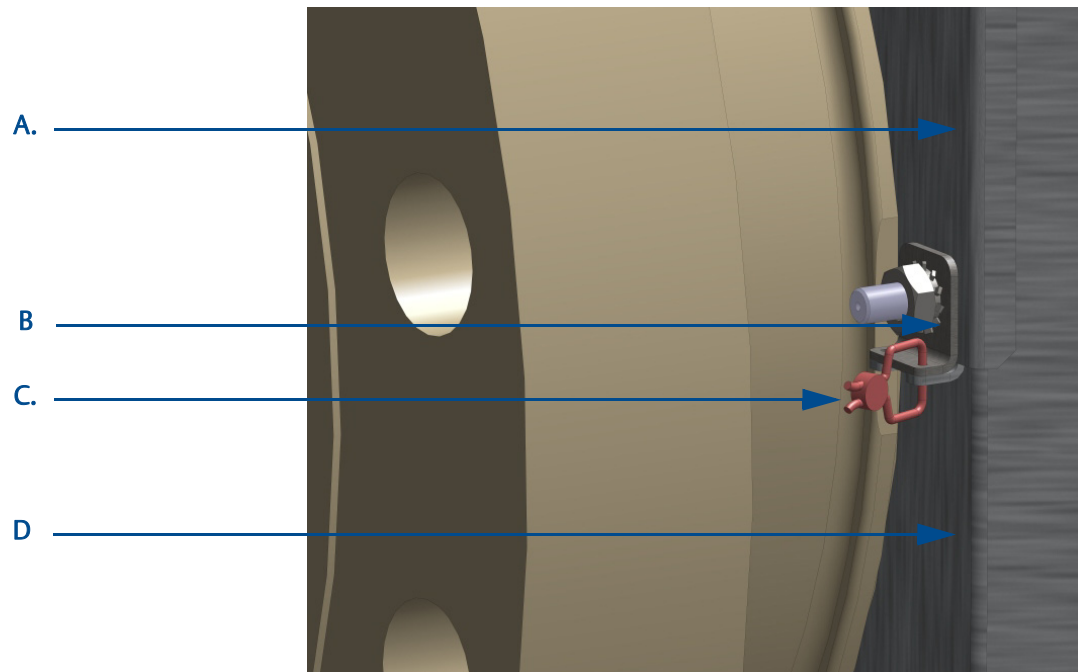
## Procedure

1. Install the security seal wire into and through the two bolt holes on the top end shrouds (maximum wire diameter .078 inch; 2.0 mm). Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut.
2. Remove all slack and seal.
3. Repeat previous step for the other top end shroud.
4. Cut wire ends to remove excess wire.
5. This completes the clamped band shroud security seal installation procedure.

### 3.7.6 Split shroud security seals

Use the following instructions to install the security seal wires on the split shroud covering the meter body and transducer assemblies.

**Figure 3-14 Split shroud security seals**



- A. Upper split shroud
- B. Split shroud clamp
- C. Security wire seals
- D. Lower split shroud

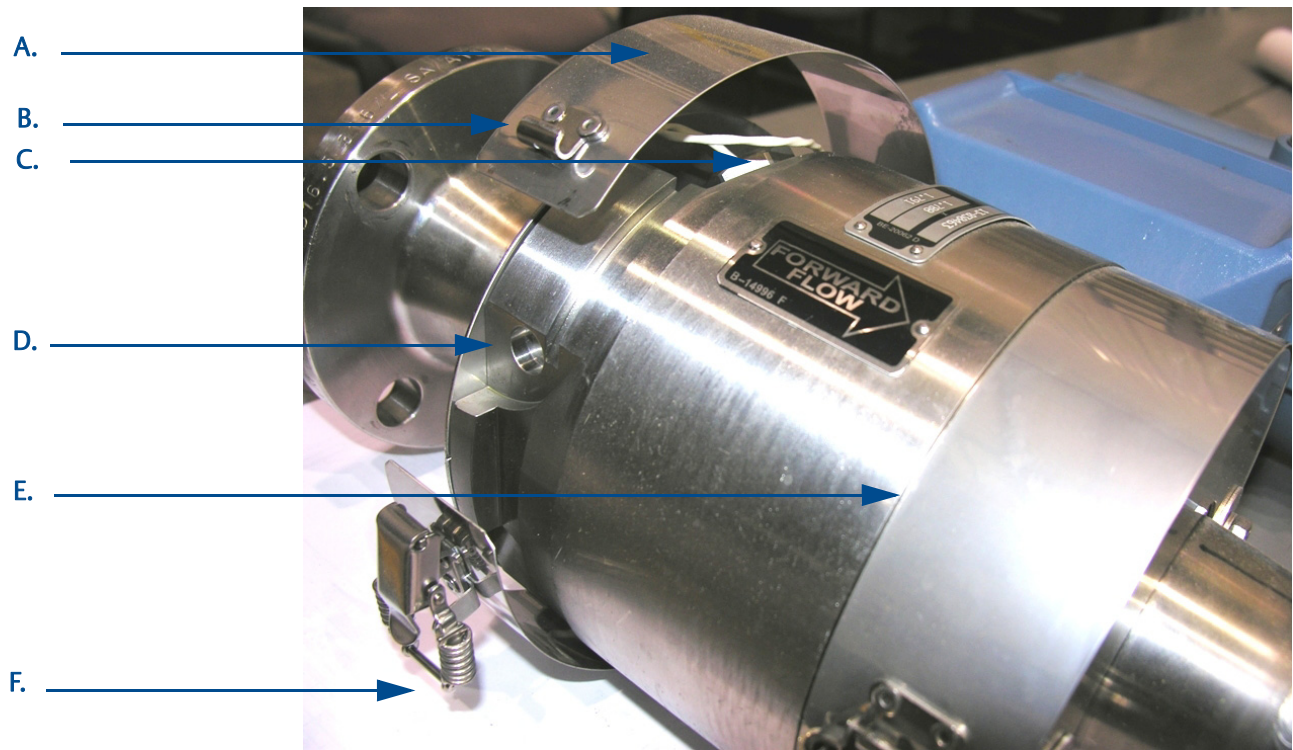
#### Procedure

1. Install the security seal wire into and through the holes in the split shroud clamp bent tab and the upper split shroud bent tab. (maximum wire diameter .078 inch; 2.0 mm).
2. Remove all slack and seal.
3. Cut wire ends to remove excess wire.
4. Repeat these steps for the other split shroud clamps.
5. This completes the split shroud security seal installation procedure.

### 3.7.7 Latched band shroud security seals

Use the following instructions to install the security seal wires on the latched band shrouds covering the meter body and transducer assemblies.

Figure 3-15 Latched band shroud assembly

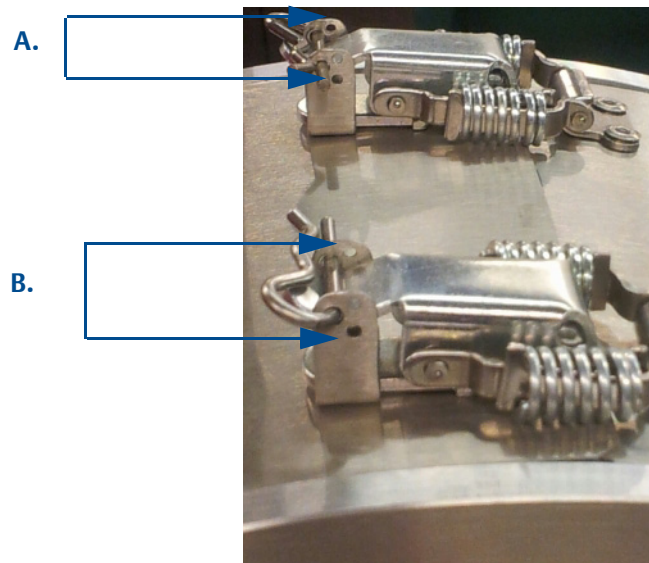


- A. Band shroud
- B. Stainless steel strike
- C. Transducer cable
- D. Meter body recess for pop rivet allowance
- E. Meter body shoulder
- F. Shroud latch

## Procedure

1. Install the security seal wire into and through the holes in one of the shroud latches (maximum wire diameter .078 inch; 2.0 mm).

**Figure 3-16 Shroud latch holes for security wire seals**



**A. Left shroud latch holes for security wire seals  
B. Right shroud holes for security wires**

2. Remove all slack and seal.
3. Cut wire ends to remove excess wire.
4. Repeat these steps for the other shroud latch.
5. This completes the split shroud security seal installation procedure.

### 3.7.8 Seal conduit ports

The unit should be properly sealed with a sealing compound after electrical connections have been tested according to the customer's Best Practices schedule. Some areas require a witnessed Acceptance Test for the installed system and require that the meter run for a predetermined length of time (approximately one to two weeks) before the unit is sealed. This allows time to verify all electrical connections are correct, that the meter is accurately measuring flow and that the meter meets the customer's installation requirements. [See Section 3.4.1](#) and [Section 3.4.2](#).



## Section 4: Configuration

After the mechanical and electrical installation is complete and connectivity is established, use the *Daniel MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (P/N 3-9000-763) to setup initial communications with the meter.

### 4.1 Daniel MeterLink setup

1. Review the software operating system, hardware and peripheral requirements.
2. Follow the installation instructions for your operating system (Windows® XP, Windows Vista, Windows® 7 or Windows® 8).
3. Configure a direct connection driver for first time modem configuration for Daniel MeterLink communications.
4. Select the Daniel MeterLink desktop icon and complete the information in the Registration Wizard. This wizard will appear the when you first run Daniel MeterLink and will provide you the following options.

Options:
Register by e-mail <ul style="list-style-type: none"><li>• Select this option and click Next to register by e-mail. Your machine must be connected to the Internet and have a default mail utility (i.e. Microsoft® Office Outlook®, Outlook® Express, etc.) configured to use this option.</li></ul>
Register by phone <ul style="list-style-type: none"><li>• Select this option to register by phone. After clicking Next, a page will display with phone numbers to dial.</li></ul>
Register later (remind me) <ul style="list-style-type: none"><li>• Select this option if you do not wish to register now, but would still like the wizard to appear the next time you run MeterLink.</li></ul>
Register later using the Help   Register Program menu item (don't remind me) <ul style="list-style-type: none"><li>• Select this option if you do not wish to register now and do not want this wizard to appear the next time you run MeterLink. You can still register at a later time by selecting Register Program from the Help menu</li></ul>

5. Select **File>Program Settings** and customize the user-preferences (e.g. User name, Company name, display units, Liquid Meter volume units and other interface settings)
6. Connect to your meter. If your meter is not shown in the list, select **Edit Meter Directory** and setup the connections properties.
7. Run the Field Setup Wizard.

## 4.2 Field Setup Wizard

1. Use the Field Setup Wizard-Startup Page and select the checkboxes that allow proper configuration for your meter (Temperature, Pressure, Meter Corrections, and Meter Outputs). Selections on this page will affect other configuration selections. Select **Next** to continue to General setup.
2. On General setup page configure the meter's system units (U.S Customary or Metric units) volume units, flow rate time, low flow cutoff, contract hour and enable reverse flow. Click **Next** to continue to Frequency Outputs.
3. Configure Frequency output 1 and Frequency output 2 content (Daniel Liquid Ultrasonic Meters content is Uncorrected flow rate), flow direction, Channel B phase, maximum frequency output (Hertz) and Full scale volumetric flow rate. Click **Next** to continue to Meter Digital Outputs.
4. Select the Meter Digital Output parameters for Digital output 1A, Digital output 1B, Digital output 2A and Digital output 2B based on Frequency validity or flow direction.

if the output of the ultrasonic meter is reversed from what a flow computer is expecting, select Inverted Operation. This changes the digital output from a HIGH for a TRUE condition to output a LOW for a TRUE condition. Click **Next** to continue to Current Outputs.

5. Current Outputs are based on Uncorrected (Actual) flow rate) content, flow direction (Forward, Reverse or Absolute) and Full scale volumetric flow rate used with output (20mA maximum). Alarm action parameters determines the state the output will drive during an alarm condition (High 20mA, Low - 4 mA, Hold last value, Very low - 3.5, Very high 20.5 mA or None). Click **Next** to continue to configure the HART® Output(s) parameters.
6. HART® Output parameters include four Dynamic process variables (Primary, Secondary, Third and Fourth variable. The Primary variable is set to match the Content set for Current output 1. If a second current output is available, the Secondary variable is set to match the Content set for Current output 1) Identification and HART® units (volume units, Flow rate time units, Velocity units, Pressure and Temperature units). Click **Next** to continue to Temperature and Pressure.
7. Set the temperature and pressure scaling for analog inputs, enter fixed values, and set alarm limits for both.
8. Select **Finish** to write the configuration settings to the meter.
9. Configure the parameters for the local display. Use the drop-down arrow in the Display Items list box and select or modify the Display items, the Display units and the Scroll delay.



## Display Items

The valid labels, descriptions and units for the shown below:

**Table 4-1 Local display labels, descriptions and valid units**

Local Display labels, descriptions and units
QFLOW – Uncorrected volume flow rate <ul style="list-style-type: none"><li>• BBL — Barrels</li><li>• GAL — Gallons</li><li>• L — Liters</li><li>• CM — Cubic Meters</li><li>• MCM — Thousand Cubic Meters</li></ul>
TDYVL – Current day’s forward uncorrected volume <ul style="list-style-type: none"><li>• +BBL — Barrels</li><li>• +GAL — Gallons</li><li>• +L — Liters</li><li>• +CM — Cubic Meters</li><li>• +MCM — Thousand Cubic Meters</li></ul>
TDYVL – Current day’s reverse uncorrected volume <ul style="list-style-type: none"><li>• -BBL — Barrels</li><li>• -GAL — Gallons</li><li>• -L — Liters</li><li>• -CM — Cubic Meters</li><li>• -MCM — Thousand Cubic Meters</li></ul>
YSTVL – Previous day’s forward uncorrected volume <ul style="list-style-type: none"><li>• +BBL — Barrels</li><li>• +GAL — Gallons</li><li>• +L — Liters</li><li>• +CM — Cubic Meters</li><li>• +MCM — Thousand Cubic Meters</li></ul>
YSTVL – Previous day’s reverse uncorrected volume <ul style="list-style-type: none"><li>• -BBL — Barrels</li><li>• -GAL — Gallons</li><li>• -L — Liters</li><li>• -CM — Cubic Meters</li><li>• -MCM — Thousand Cubic Meters</li></ul>
TOTVL – Forward uncorrected volume <ul style="list-style-type: none"><li>• +BBL — Barrels</li><li>• +GAL — Gallons</li><li>• +L — Liters</li><li>• +CM — Cubic Meters</li><li>• +MCM — Thousand Cubic Meters</li></ul>
TOTVL – Reverse uncorrected volume <ul style="list-style-type: none"><li>• -BBL — Barrels</li><li>• -GAL — Gallons</li><li>• -L — Liters</li><li>• -CM — Cubic Meters</li><li>• -MCM — Thousand Cubic Meters</li></ul>

**Table 4-1 Local display labels, descriptions and valid units**

Local Display labels, descriptions and units	
VEL – Average flow velocity	<ul style="list-style-type: none"> <li>• Ft/S — Feet per second</li> <li>• M/S — Meters per second</li> </ul>
SOS – Average sound velocity	<ul style="list-style-type: none"> <li>• Ft/S — Feet per second</li> <li>• M/S — Meters per second</li> </ul>
TEMP – Flow-condition temperature	<ul style="list-style-type: none"> <li>• DEGF — Degrees Fahrenheit</li> <li>• DEGC — Degrees Celsius</li> </ul>
PRESS – Flow-condition pressure	<ul style="list-style-type: none"> <li>• PSI — Pound per square inch</li> <li>• MPA — Megapascals</li> </ul>
FRQ1A – Frequency channel 1A	<ul style="list-style-type: none"> <li>• HZ — Hertz</li> </ul>
FRQ1B – Frequency channel 1B	<ul style="list-style-type: none"> <li>• HZ — Hertz</li> </ul>
KFCT1 – Frequency 1 K-factor	<ul style="list-style-type: none"> <li>• BBL — Barrels</li> <li>• GAL — Gallons</li> <li>• L — Liters</li> <li>• CM — Cubic Meters</li> <li>• MCM — Thousand Cubic Meters</li> </ul>
FRQ2A – Frequency channel 2A	<ul style="list-style-type: none"> <li>• HZ — Hertz</li> </ul>
FRQ2B – Frequency channel 2B	<ul style="list-style-type: none"> <li>• HZ — Hertz</li> </ul>
KFCT2 – Frequency 2 K-factor	<ul style="list-style-type: none"> <li>• BBL — Barrels</li> <li>• GAL — Gallons</li> <li>• L — Liters</li> <li>• CM — Cubic Meters</li> <li>• MCM — Thousand Cubic Meters</li> </ul>
AO1 – Analog Output 1 current	<ul style="list-style-type: none"> <li>• MA — Milliamperes</li> </ul>
AO2 – Analog Output 2 current	<ul style="list-style-type: none"> <li>• MA — Milliamperes</li> </ul>
<b>Note:</b> When connected to a meter with the optional local display, reverse flow direction is indicated with a minus sign (negative) before the value(s) shown on the display.	

## Display units

The Meter volume units displayed are either U.S. Customary or Metric. To modify the Display Units, configure the Meter units system in the Field Setup Wizard – General Page.

- U.S. Customary volume unit selections are:
  - Barrels
  - Gallons
- Metric volume unit selections are:
  - Cubic meters
  - Cubic liters
- Display units preceded by a plus or minus sign indicate forward and reverse flow direction.
- The Local Display Flow rate time units are modifiable by selecting the drop-down arrow and clicking the time unit in the list box.
- Valid flow rate time units selections are:
  - second
  - minute
  - hour
  - day

## Scroll delay

The Scroll Delay is the time interval for the selected display items to be shown on the Local Display. The default scroll delay setting is five seconds. Click the spin box up or down arrow to increase or decrease the length of time an item displays.

1. Select **Finish** to write the configuration settings to the meter.
2. Save the meter configuration file, collect a Maintenance log and Waveforms to document the “As Left” settings.

## 4.3 Using AMS Device Manager to configure the meter

This procedure assumes you have AMS Device Manager installed on the host computer and have downloaded the latest Daniel Liquid Ultrasonic Meter Device Description (DD).

If not installed, click the link below to download the AMS device installation tool kit.

<http://www2.emersonprocess.com/en-US/documentation/deviceinstallkits/Pages/deviceinstallkitsearch.aspx>

### Procedure - installing AMS Device Description

1. Use the link above to search for the Device Description (DD) for your Daniel 3810 Series Liquid Ultrasonic Flow Meter.
2. Use the pull-down menu and select the Brand/Manufacturer - **Emerson Daniel Industries**.
3. Next select the Device, **Liquid 3810 Series** from the pull-down menu.
4. Choose the **Device Revision1**, from the pull-down menu.
5. Next, select **HART** from the Communication Protocol menu.
6. Select **AMS Device Manager** for the Host System.
7. Select the **Host System Revision 11.5**.
8. Verify your search parameters are correct, as shown below.

**Figure 4-1 AMS Device Description search**

#### Search Device Install Kits

Brand/Manufacturer:  
Emerson Daniel Industries

Device:  
Liquid 3810 Series

Device Revision:  
1

Communication Protocol:  
HART

Host System:  
AMS Device Manager

Host System Revision:  
11.5

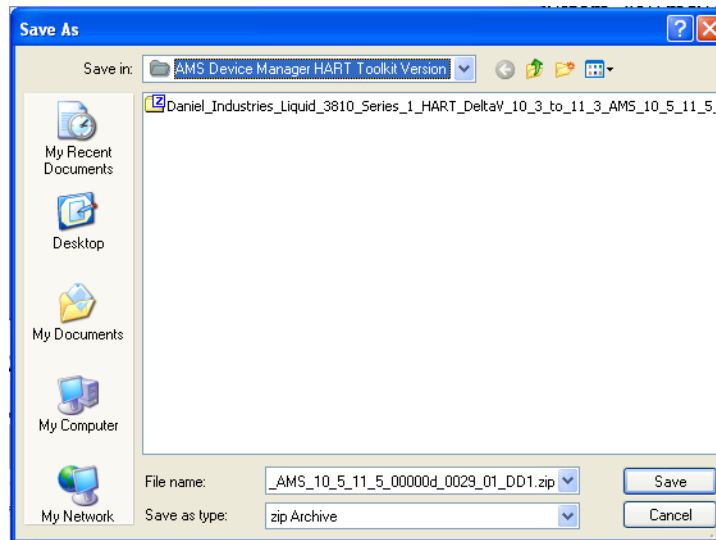
SEARCH NOW > [RESET SEARCH]

9. Click **Search Now**.

10. Click the **Daniel Industries Liquid 3810 Series Rev 1** hyperlink. The file download dialog displays. Click the **Save** button to save the files to your host system. You may use the default download location or change the directory.

---

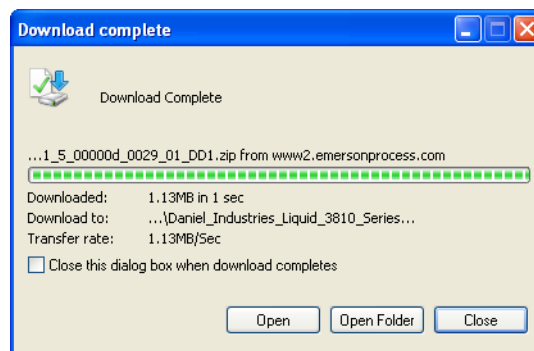
11. **AMS file download options**



- 
12. Click the **Save** button to complete the file download.

---

**Figure 4-2 AMS file download complete**



- 
13. Click **Open** or **Open Folder** to view the downloaded files.
  14. Establish power to the meter and wiring to Analog Input 1 for HART communication.
  15. Start the AMS Device Manager using a laptop or PC.
  16. Enter login credentials and click **OK** to launch the application.

17. Click the Configure tab, and then select **Guided Setup**, **Manual Setup** or **Alert Setup**.

Figure 4-3 AMS Device Manager

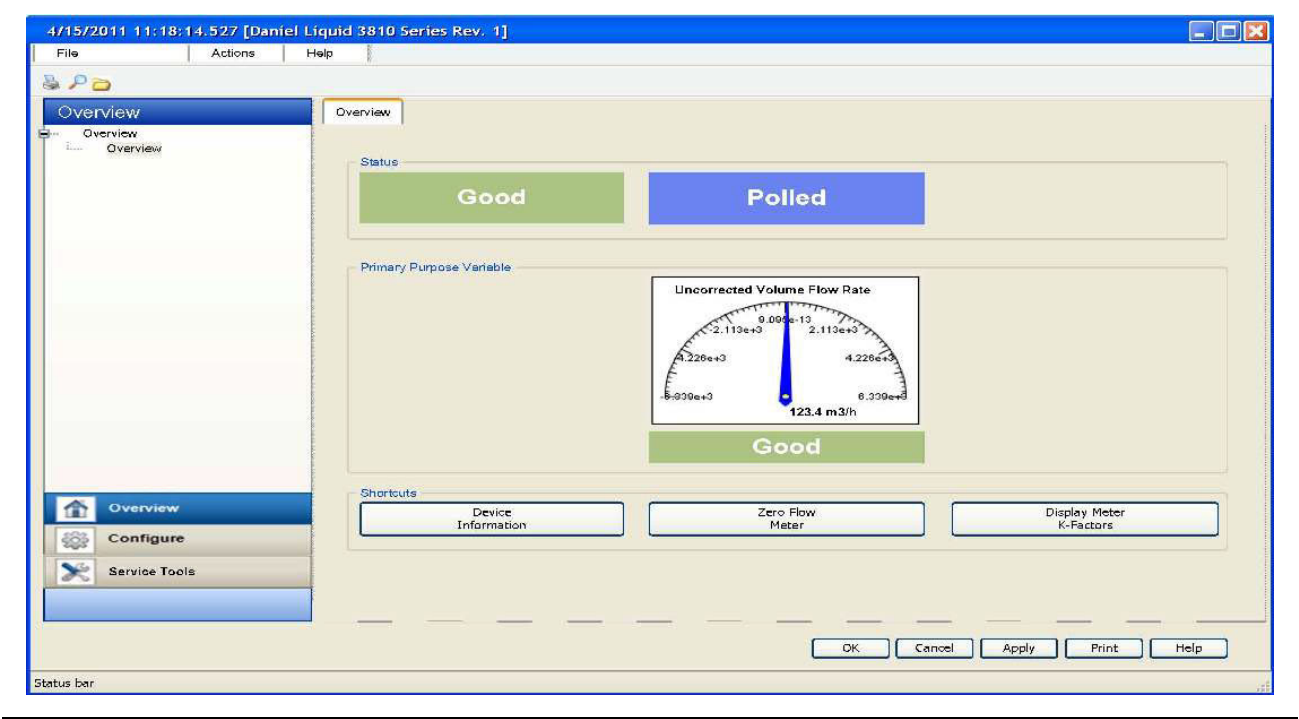
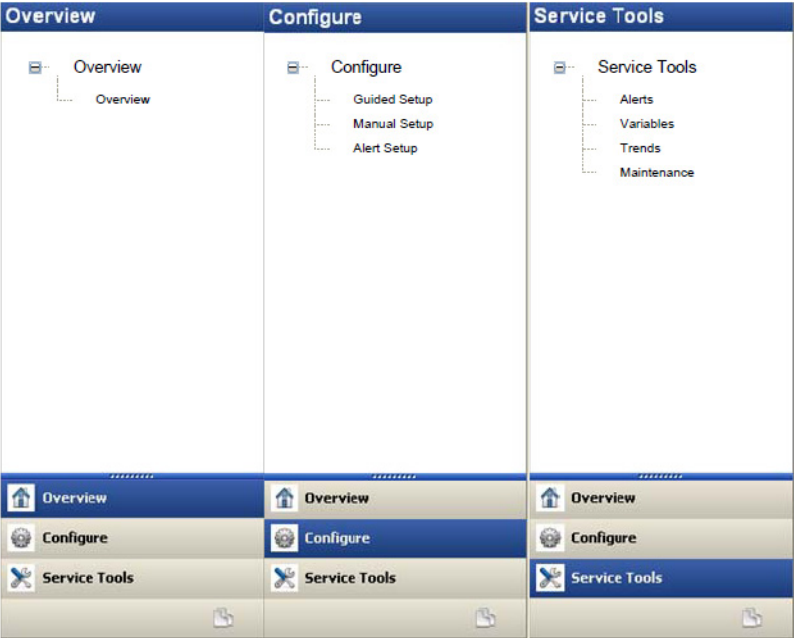


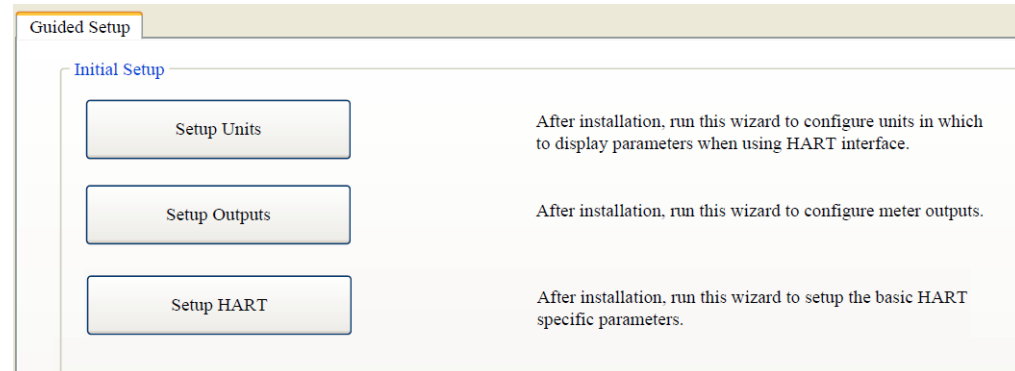
Figure 4-4 AMS Device Manager - Overview



### AMS Device Manager - Guided Setup

The Guided setup wizard provides configuration parameter settings for the meter. The Guided Setup is a subset of the Manual Setup parameters.

Figure 4-5 AMS Device Manager - Guided Setup



**Note:** Before writing configuration changes to your meter, make sure you have saved the Configuration file and Maintenance log.

#### Procedure

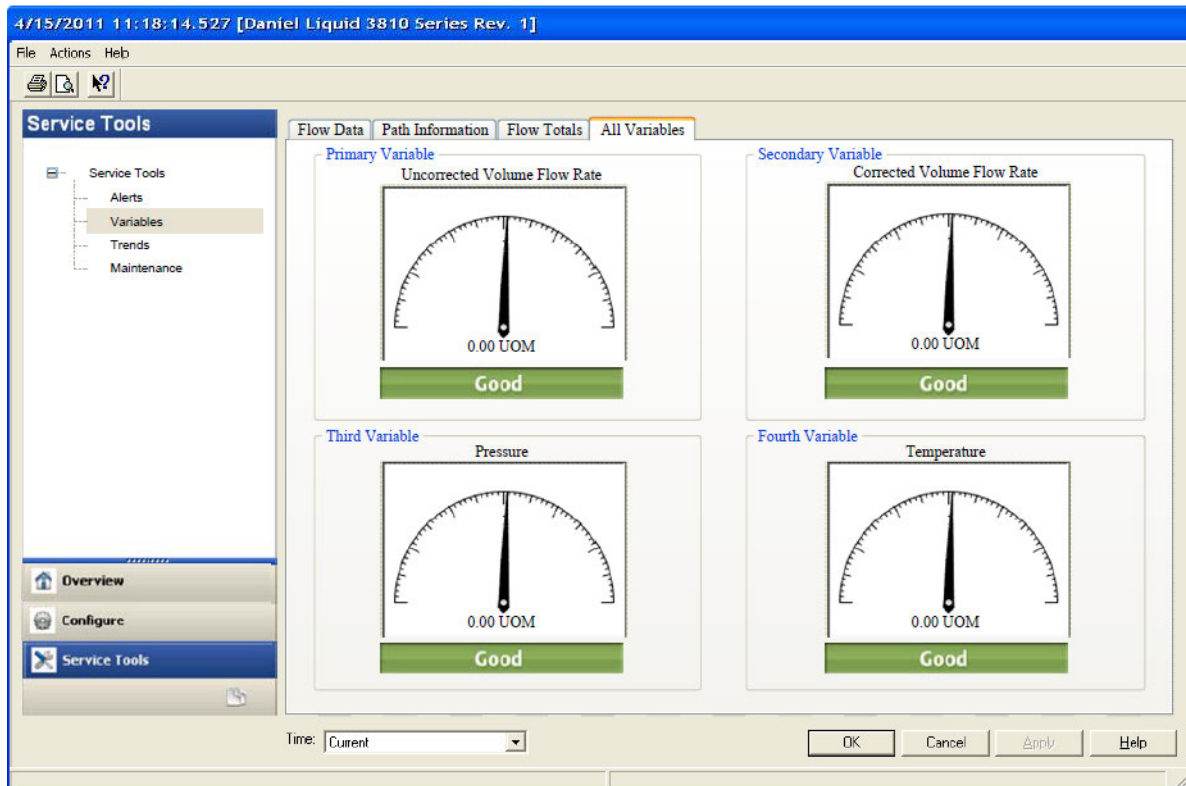
1. Disable the Write Protect switch in the CPU Module to write any of the following configuration parameters to your meter.
2. Click the **Setup Units** tab to configure the system units (U.S. Customary or Metric units), Volume units, Flow rate time units, Velocity units, Pressure units and Temperature units. Click **Apply** to write the parameters to the meter.
3. Click the **Setup Outputs** tab to configure the Device Variables Mapping, Units, Frequency/Digital outputs, Frequency and Digital Outputs 1 and 2, Analog outputs, Digital Input, Pressure and Temperature.
  - a. Analog output 1 (HART) - **Content (Primary Variable)** displays Uncorrected Flow Rate and is a read only attribute). Configure **Direction** (flow), **Lower Range value**, **Upper range value** and **Alarm Action** and view the **HART Parameters** Tag, Date, Descriptor, Message, Final Assembly Number Poll Address, Number of Response Preambles.
  - b. Analog Output 2 - **Content (Secondary Variable)** displays Uncorrected Flow Rate and has a read only attribute. Configure **Direction** (flow), **Lower Range value**, **Upper range value** and **Alarm Action**. Map the Third and Four variables using the Manual Setup wizard. Selections include Uncorrected Volume Flow Rate, Pressure and Temperature.

4. After all of the data shown below is entered, click **Apply** to write the parameters to the meter.
  - a. Click the **Frequency/Digital Outputs** tab to configure Frequency/Digital Output 1, 2 and 3 Source and drive Mode. Select the Source for each Frequency/Digital output and select the desired drive Mode. The Mode options are Open Collector which requires an external excitation voltage and pull-up resistor or TTL mode which outputs a 0-5 VDC signal (each Frequency output has an A and B output phase). (**Refresh Note:** If changes are made to any Source variable on this page, apply the changes and navigate to the Guided Setup page. Navigate back to the Manual Setup for the changes to be reflected in other Manual Setup pages).
  - b. Click the **Frequency and Digital Output 1** tab to configure the Content, (flow) Direction, Channel B Phase frequency output, Lag forward, Lead Reverse or Lead Forward, Lag Reverse (Phase B lags Phase A while reporting forward flow and lead Phase A while reporting reverse flow or the opposite), Digital Output 1 Channel A Content and Polarity, Channel B Content and Polarity, Maximum Frequency, and Lower and Upper Range Units of Measure.
  - c. Click the **Frequency and Digital Output 2** tab and repeat Step 3b to configure Frequency and Digital Output 2 parameters.
5. Click **Setup HART** to configure the HART parameters (tag, date, descriptor, message text, Final Assembly number, Poll address and number of response preambles are displayed). After all of the data is entered click **Apply** to write the parameters to the meter.
6. On the Overview page, click **Alert Setup** and select the **Flow Analysis** tab and enable Reverse Flow. Click the **OK** button to return to the Overview page.
7. On the Overview page, click the **Service Tools** tab and select the **Variables** tab. The Flow Data, Path Information, Flow Totals, and All Variables data is populated after you are connected to the meter.
  - a. Click the **Flow Data** tab and view the Flow Direction (Forward or Reverse), Average Flow and Average Sound Velocities values.
  - b. Click the **Path Information** tab and view the Chord performance, Gain, SNR (Signal to Noise Ratio) Signal strength (mV), and Noise (mV).
  - c. Click the **Flow Totals** tab to view the volume totals (forward and reverse uncorrected volume).



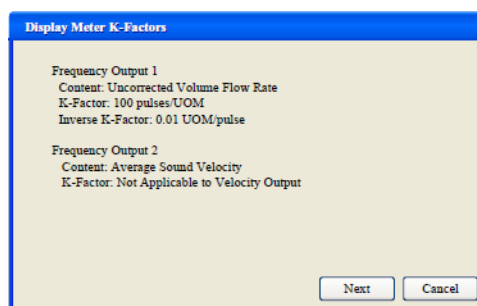
- d. Click the **All Variables** tab to view a graphical display of the Primary, Secondary, Third and Fourth Variables.

Figure 4-6 AMS Device Manager - Service Tools All Variables status indicators



8. Click **OK** to return to the Overview page.
9. Enable the Write Protect switch on the CPU Module to protect the meter's configuration.
10. From the Overview window, click **Display Meter K-Factors**. K-Factors are a read-only values calculated from the Full scale volumetric flow rate used with frequency outputs and the Maximum frequency for frequency output.

Figure 4-7 Display Meter K-Factors

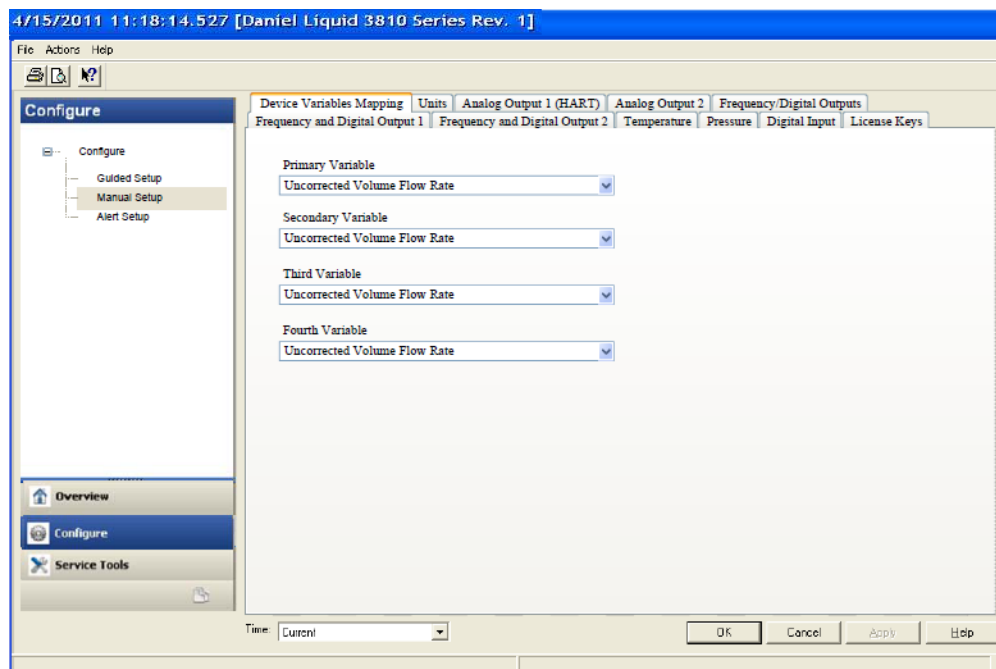


Click **Next** to return to the Device Manager Overview page.

### AMS Device Manager - Manual Setup

Use the **Manual Setup** wizard to configure the meter's parameters. See [Figure 4-3](#) and [Figure 4-4](#) and from the AMS Device Manager Configure menu click **Manual Setup**.

**Figure 4-8 AMS Device Manager - Configure Manual Setup**



### Procedure

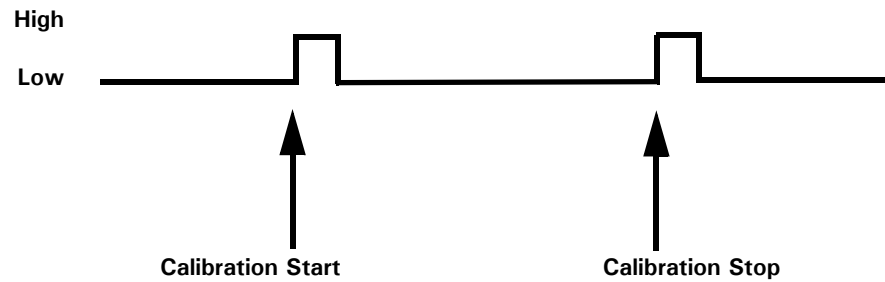
1. If installed, remove security wires from the endcap and the Bracket/Cover hex head bolts that secures the Base Enclosure.
1. Disable the Write Protect switch in the CPU Module to write any of the following configuration parameters to your meter.
2. Click the **Device Variables Mapping** tab. The Primary and Secondary variables are read only and are configured for Uncorrected Flow Rate. The Third and Fourth variable configuration choices include Pressure and Temperature.
3. Click the **Units** tab (see [AMS Device Manager - Guided Setup, Step 1](#)).
4. Click the **Analog Output 1 (HART)** tab (see [AMS Device Manager - Guided Setup, Step 2a.](#)).
5. Click the **Analog Output 2** tab. Follow the configuration instructions in the [AMS Device Manager - Guided Setup, Step 2b](#). The read only Secondary variable Content, Uncorrected Flow Rate, displays. Use the drop-down arrow and select the (flow) Direction - Forward or Reverse. Enter a Lower and Upper Range limit. Set the Alarm Action parameters. Click **Apply**, after you enter the data to write the parameters to the meter.
6. Click the **Frequency/Digital** Outputs tab. Follow the configuration instructions in the [AMS Device Manager - Guided Setup, Step 3 a.](#) (**Refresh Note:** If changes are made to any Source variable on this page, apply the changes and navigate to the Guided Setup

page. Navigate back to the Manual Setup for the changes to be reflected in other Manual Setup pages). Click **Apply**, after you enter the data to write the parameters to the meter.

7. Click the **Frequency and Digital Output 1** tab. Follow the configuration instructions in the [AMS Device Manager - Guided Setup, Step 3b](#). Click **Apply**, after you enter the data to write the parameters to the meter.
8. Click the **Frequency and Digital Output 2** tab. Follow the instructions in the [AMS Device Manager - Guided Setup, Step 3c](#) to configure the Frequency and Digital Output 2 parameters. Click **Apply**, after you enter the data to write the parameters to the meter.
9. Click the **Temperature** tab. Configure the input parameters including: Source (Live Analog or Fixed), Min and Max input limits corresponding to 4 mA and 20 mA respectively and the Low and High alarm limits. Click **Apply**, after you enter the data to write the parameters to the meter.
10. Click the **Pressure** tab. Configure the input parameters including: Source (Live Analog or Fixed), Min and Max input limits corresponding to 4 mA and 20 mA respectively and the Low and High alarm limits. Select either **Gage** or **Absolute** for the type of pressure reading desired. If a live pressure transmitter is connected, select the type of reading the transmitter outputs. If Absolute is selected, you must also enter the Atmospheric pressure. Click **Apply**, after you enter the data to write the parameters to the meter.
11. Click the **Digital Input** tab. The default Digital Input 1 polarity is set to **Normal** for general purpose or set to **Inverted** when used for calibration. Click **Apply**, after you choose the calibration data to write the parameters to the meter.
  - a. Calibration Polarity configuration parameter selections are:
    - Digital Input 1 Calibrate Active High
    - Digital Input 1 Calibrate Active Low

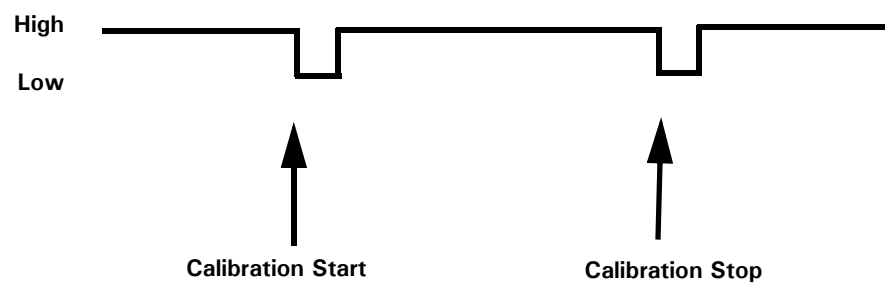
- b. Calibration Gating configuration parameter selections are:
- Edge gated, active high

**Figure 4-9 Gating configuration parameter Edge gated, active high**



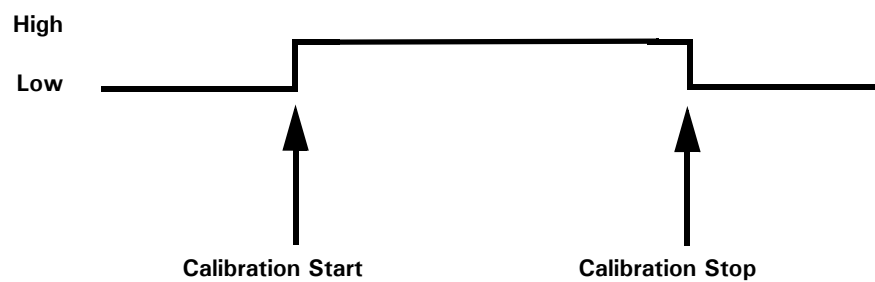
- Edge gated, active low

**Figure 4-10 Gating configuration parameter Edge gated, active low**



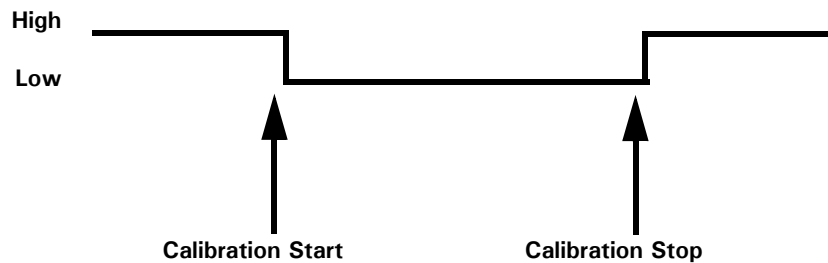
- State gated, active high

**Figure 4-11 Gating configuration parameter State gated, active high**



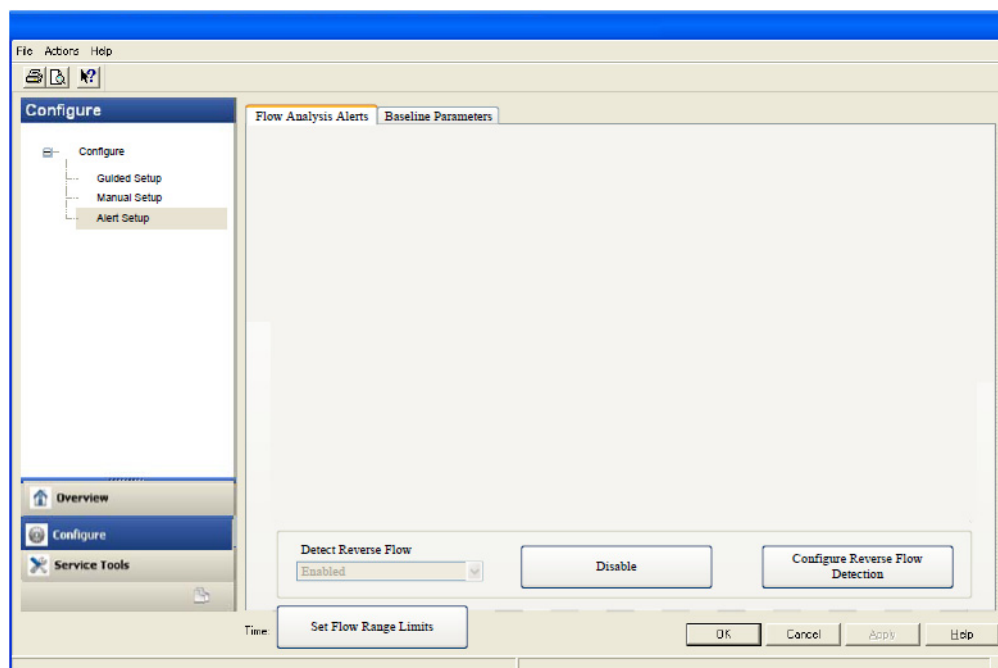
— State gated, active low

Figure 4-12 Gating configuration parameter State gated, active low



12. Click the **Alert Setup** tab (from the main Configuration page).

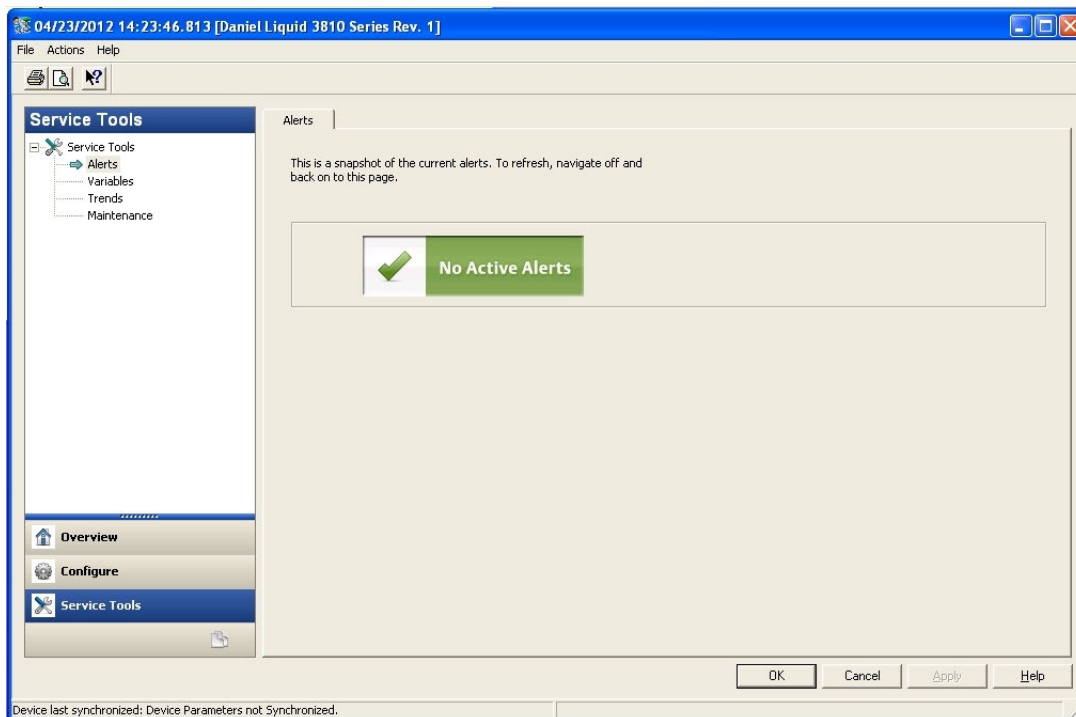
Figure 4-13 Configure Flow Analysis Alert



13. Click the **Flow Analysis** tab to select Configure Reverse Flow Detection, if desired. The default setting is **Disabled**. Click the **Disabled** button to send the feature command to the meter. Check for a response error. If no error response is received, click the **Enable** button.
  - a. Enter the minimum reverse flow velocity above which to accumulate flow in the reverse direction for this alert. Enter a positive value for the Reverse Flow Zero Cutoff. Click the **Next** button to write the values to the meter. Check for an error response. If no error response is received, click the **Next** button. The Detect Reverse Flow enabled page displays. Click the **Next** button to display Detect Reverse Flow disabled.
  - b. If an error message is returned, click the **Next** button to display the Method Complete page.
  - c. Click the **Set Flow Range Limits** button and enter a positive value for the Flow Analysis Lower Velocity Range and the Upper Velocity Range Limits. When the velocity is outside of the limit parameters, an alert is triggered. Click the **Next** button to display the Method Complete page.

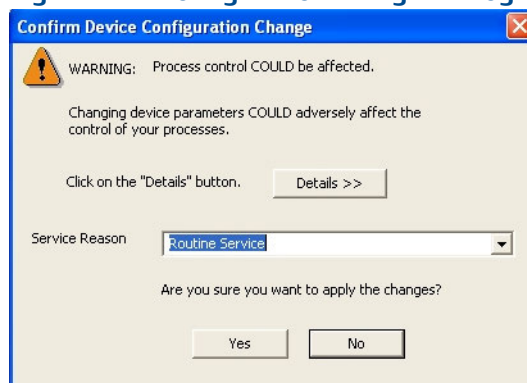
14. Click the **Service Tools** tab to access the device alerts, variables, trends and maintenance statuses or to edit the configuration parameters.
  - a. Click the **Service Tools | Alerts** tab. If an alert condition exists, the alert type and description displays. Recommended actions are listed to assist you in a resolution. After you resolve the alert condition, click the **Acknowledge** button to clear the alert. Click **Apply** to write the changes to the meter. If no alert condition is active, click **OK** to close the device window.

Figure 4-14 AMS Device Manager - Service Tools Alerts



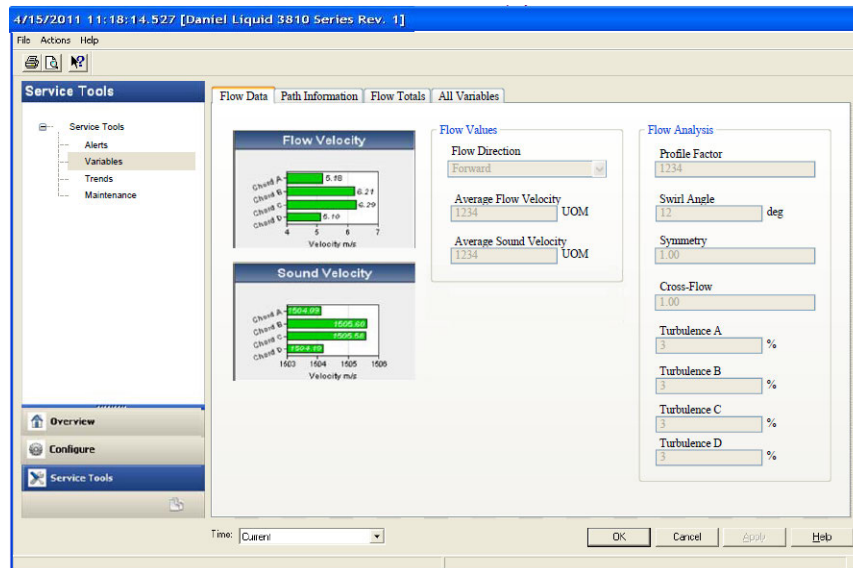
- b. If you change the device configuration, a confirmation dialog displays and prompts you to write the changes to the meter. Click **Yes** to write the changes to the meter or click **No** to cancel pending changes.

Figure 4-15 Configuration changes dialog



- c. Click the **Service Tools|Variables** tab. The Variables page displays tabs for the device's Flow Data, Path Information, Flow Totals, and All Variables).

Figure 4-16 AMS Device Manager - Service Tools

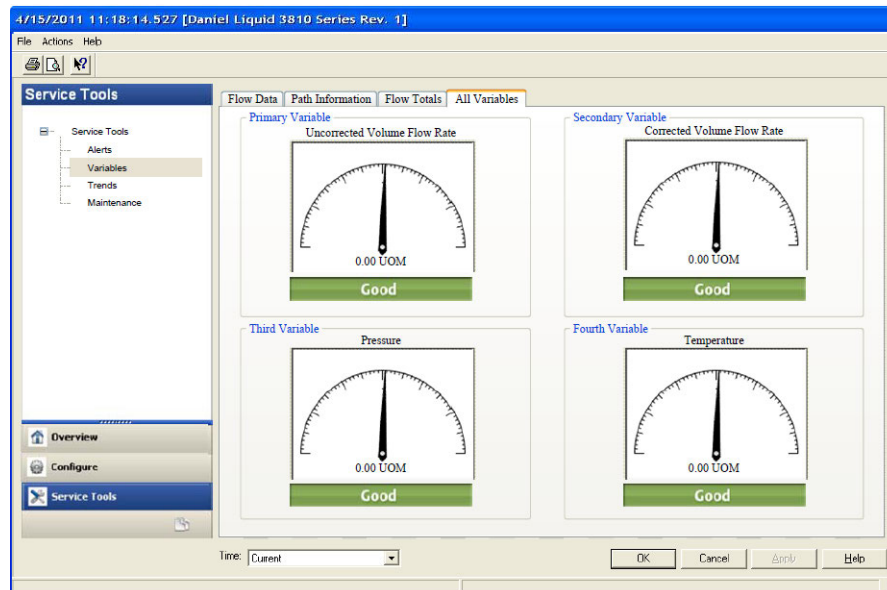


- d. The **Service Tools|Flow Data** page includes charts for flow and sound velocities. The flow values (flow direction, average flow velocity and average sound velocity) parameters are displayed for the connected device.
- e. Click **Service Tools|Variables|Path Information** tab to view the device's chord performance (%), Gain (dB), SNR (dB), Signal (mV) and Noise (mV).
- f. Click **Service Tools|Variables|Flow Totals** to view the volume totals (Forward and reverse Uncorrected Volume) parameters for the connected device.



- g. Click **Service Tools | Variables | All Variables** tab to view Primary, Secondary, Third and Fourth Variable parameter status.

Figure 4-17 AMS Device Manager - Service Tools All Variables



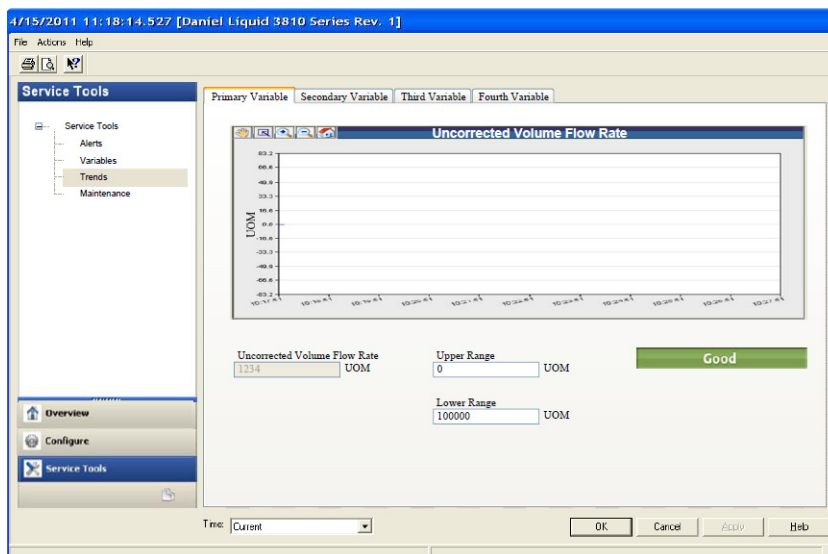
Gauges display each variable's status as good or bad. If a status is bad refer to the Service Tools Alerts page for recommended actions to resolve the alert condition. Also refer to the Field Device Specification manual (P/N 3-9000-762) for Commands 48 and 140 details.

### IMPORTANT

Alerts are triggered for Command 48 Additional device status and Command 140 detailed status information. Alerts are grouped as Failed - Fix Now, Maintenance - Fix Soon and Advisory according to the severity level; 1-6. Severity 1 is the highest and 6 is the lowest level.

- h. Click the **Service Tools | Trends** tab to display the device variables (uncorrected volume flow rate, pressure and temperature) trends.

Figure 4-18 AMS Device Manager - Service Tools Trends



Primary and Secondary variables display real-time uncorrected volume flow rate trends. The third and fourth variables charts displays trends for temperature and pressure.

15. Click the **Service Tools | Routine Maintenance** tab. Click **Analog Output 1 Trim** to perform a digital to analog trim adjustment of the first milliampere output. The 4mA and 20mA output current values should equal the plant's standard values. Click **Yes** to confirm the configuration changes. Repeat this step to trim Analog Output 2 current. Click **Apply** to write the output trim values to the meter. Click **OK** to navigate back to the Service Tools page.
16. Click the **Service Tools | Zero Calibration** tab. See [AMS Device Manager - Guided Setup Step 6](#) to configure the zero flow parameters.
17. After you have changed and written the configuration changes to the meter do the following:
  - a. Enable the Write Protect switch on the CPU Module to protect the meter's configuration.
  - b. Replace the end cap and if required, apply security seals through the endcap holes and through the hex head bolts that secure the Bracket/Cover to the Base enclosure.

**Note:** The next time you connect to the device using Daniel MeterLink, the Monitor page displays a Meter status alarm that the configuration has changed and remains latched until acknowledged. Click **Ack** (acknowledge) to clear the alarm.

## 4.4 Using a Field Communicator to configure the meter

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### important

Follow all guidelines and precautions described in the Field Communicator User Manual and in the 3812 Liquid Ultrasonic Flow Meter documentation when working in a hazardous area.

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### Installation Requirements

- Emerson Field Communicator software, license, installation guide and user manual available on the Emerson Asset Optimization Field Communicator website:

<http://www2.emersonprocess.com/en-US/brands/Field-Communicator/Pages/Documentation.aspx>

- Daniel HART Device Description (HART DD) installed for the meter
- Network configured for a Field Communicator
- Daniel Field Device Specification Manual (P/N 3-9000-761) available on the Daniel website

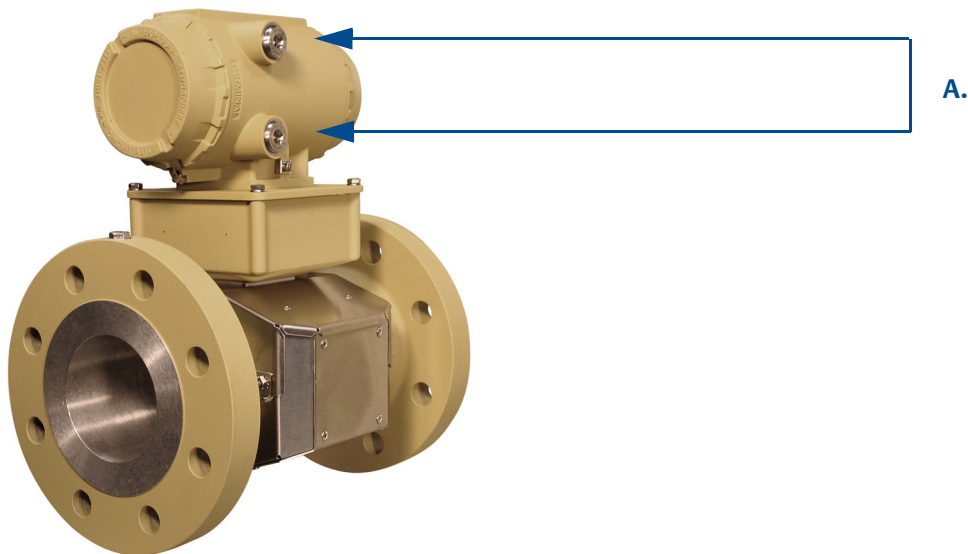
<http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/Ultrasonic.aspx>

- System wiring diagram drawing number DMC - 004936 (see Appendix A)
- Power supply

### Procedure

1. Remove electrical power to the meter. If installed, remove the endcap security latches and seals and then, remove the endcap.
2. Refer to the Field Communicator Users Manual wiring diagrams and commissioning instructions provided with your handheld device. Register the product to activate the end user license.
3. Fully charge the Field Communicator battery prior to use. **Important:** Do not change the battery in a hazardous area environment. The power supply is not intrinsically safe.
4. On the meter, run the wires through the field wiring conduit and into the transmitter electronics enclosure.

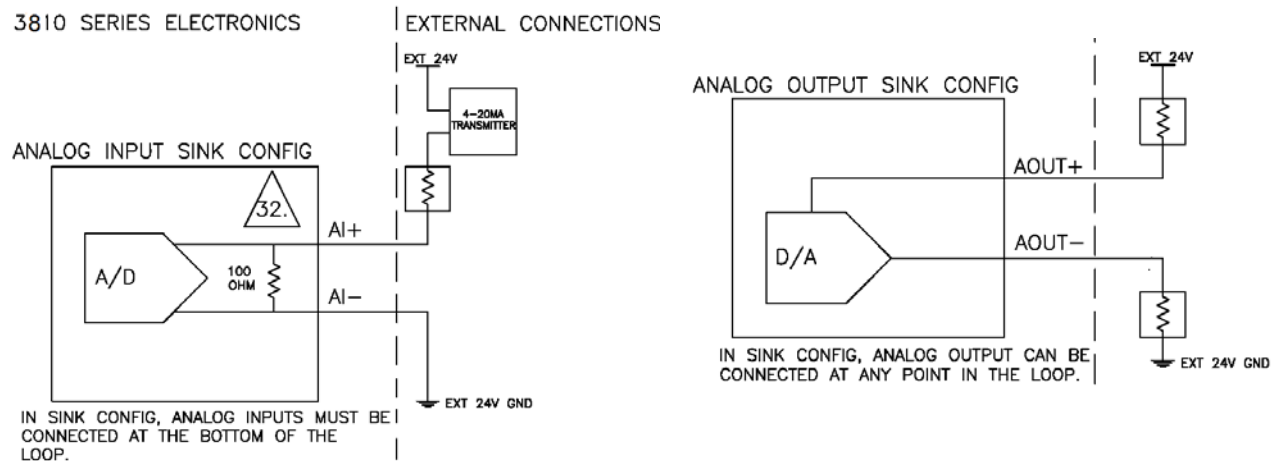
Figure 4-19 3812 transmitter field wiring conduit entries



#### A. Field wiring conduit entries (4)

5. Wire Analog Input 1 (AI1) and Analog Output 1 (AO1) as shown in Figure 4-20 and Appendix A, drawing DMC-004936.

**Figure 4-20 Field Communicator wiring diagram for the 3810 Series electronics**



6. Use the leads provided with the Field Communicator to connect to your device.
7. Press and hold the **Power** button on the Field Communicator until the green light blinks.
8. Use the touch screen on the Field Communicator, the keypad or use the stylus to navigate through the device menus.
9. Refer to the Menu tree in Section D.1.1 of the Daniel HART Field Device Specification manual (P/N 3-9000-761) for the device fast key sequences. Included in the menu tree are:
  - Diagram Page 1 - 3810 Series Root Menu; **Overview, Configure|Manual Setup**
  - Diagram Page 2 - **Configure|Manual Setup** (continued) and **Alerts Setup**
  - Diagram Page 3 - **Service Tools|Alerts and Variables**
  - Diagram Page 4 - **Service Tools|Variables** (continued), **Service Tools|Trends, and Service Tools|Maintenance**

If you encounter problems, refer to the contact information on the back cover of this manual or the contacts included in the Field Communicator Users Manual.

## 4.5 Security seals for the meter

For the integrity of the meter metrology and to prevent tampering with the transmitter electronics and transducer assemblies, attach security latches to the Shroud covering the transducer assemblies and install security wires on the Transmitter Electronics Enclosure end caps, the Base Enclosure hex head bolts, the Shroud clamps and the shroud latches ([see Section 3.7](#)).

Pour the conduit ports sealing compound according to the customer's requirements (e.g., after approximately one to two weeks of run time). Also, [see Section 3.4.1](#) and [see Section 3.4.2](#).

# Appendix A: Engineering drawings

## A.1 Daniel 3812 Liquid Ultrasonic Flow Meter drawings

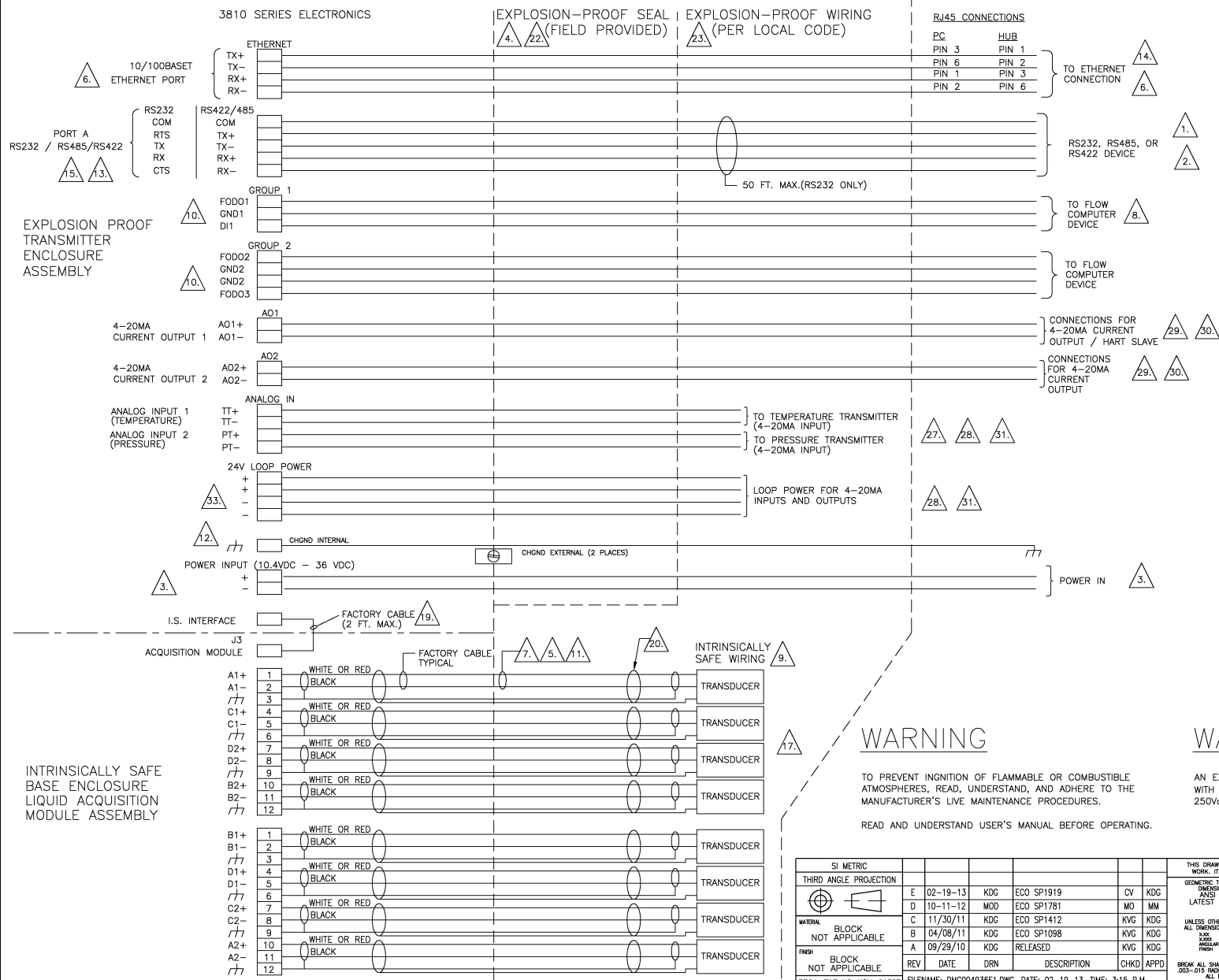
This appendix contains the following engineering drawing(s) for the ultrasonic meter:

DMC-004936 Daniel 3810 Series Ultrasonic Flow Meter System Wiring Diagram





## NON-HAZARDOUS LOCATION





## WARNING

TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE  
ATMOSPHERES, READ, UNDERSTAND, AND ADHERE TO THE  
MANUFACTURER'S LIVE MAINTENANCE PROCEDURES.

READ AND UNDERSTAND USER'S MANUAL BEFORE OPERATING.

## WARNING

AN EXTERNAL POWER SOURCE SHALL NOT APPLY A POTENTIAL WITH RESPECT TO EARTH ( $U_m$ ) IN EXCESS OF 250 Vrms OR 250Vdc TO ANY TERMINAL CONNECTION IN THIS UNIT.

SI METRIC							THIS DRAWING IN DESIGN AND DETAIL IS OUR PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH OUR WORK. IT SHALL NOT BE REPRODUCED AND SHALL BE RETURNED TO US ON DEMAND. ALL RIGHTS ARE RESERVED.														
THIRD ANGLE PROJECTION												GEOMETRIC TOLERANCES & DIMENSIONS PER ASME Y14.5-2009 LATEST REVISION									
MATERIAL		E	02-19-13	KDG	ECO	SP1919				CV	KDG	TITLE 3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM									
BLOCK NOT APPLICABLE		B	10-11-12	MOD	ECO	SP1781				MM	MM	UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES FRACTIONS DECIMALS ANGLES UNLESS NOTED OTHERWISE									
BLOCK NOT APPLICABLE		C	11/30/11	KDG	ECO	SP1412				KVG	KDG										
BLOCK NOT APPLICABLE		B	04/08/11	KDG	ECO	SP1098				KVG	KDG										
BLOCK NOT APPLICABLE		A	09/29/10	KDG	RELEASED					KVG	KDG										
FINISH		REV	DATE	DRN	DESCRIPTION							CHKD APPD									
BLOCK NOT APPLICABLE		PROJ. FILE NO. USM-01307 FILENAME: DMC0049361.DWG, DATE: 02-19-13, TIME: 3:15 PM																			
BLOCK NOT APPLICABLE		BREAK ALL SHARP CORNERS TO .003" (0.075 mm) RADIUS ALL BURNS																			
BLOCK NOT APPLICABLE		DRN KVG DATE 09/29/10 DWN MJC DRNG KVG DATE 09/29/10 APPD KVG DATE 09/29/10 SCALE NA P/N DMC-004936																			
BLOCK NOT APPLICABLE		REV E																			



# NOTES:

1. MAX LENGTH OF RS-485 WIRING IS 2,000 FT.
2. ETHERNET OR RS-422 IS THE PREFERRED COMMUNICATIONS INTERFACE. OPTIONALLY, RS-232 MAY BE USED FOR SHORT DISTANCES, (50 FT.)
3. POWER INPUT IS NOMINAL 24 VDC. INPUT RANGE 10.4-36V DC. POLARITY INSENSITIVE
4. AN EXPLOSION-PROOF SEAL IS REQUIRED WITHIN 457 MM(18 INCHES) OF THE ENCLOSURE.
5. MODEL 3814 AND 3818:  
TRANSDUCER CABLE IS 20 AWG. SHIELDED PAIR, 20 AWG DRAIN, BRAIDED SHIELD, REMKE INDUSTRIES OR EQUIVALENT, 15 FT. MAX.  
MODEL 3812:  
TRANSDUCER CABLE IS 28 AWG. SHIELDED PAIR, 15 FT. MAX.

6. FOR OPTIMUM DIAGNOSTIC INTERFACE, WIRING ETHERNET PORT IS RECOMMENDED. USE CAT5 ETHERNET CABLE
7. INTRINSICALLY SAFE WIRING SHALL BE INSTALLED IN ACCORDANCE WITH THE ARTICLE 504 OF THE NATIONAL ELECTRICAL CODE OR RULE 18-066 OF THE CANADIAN ELECTRICAL CODE.
8. DIGITAL INPUT 1 IS CONTACT CLOSURE ONLY.
9. TRANSDUCER PAIRS REQUIRED

MODEL NO.	TRANSDUCER PAIRS REQUIRED	TYPICAL CHORDS USED
3814	4	A,B,C,D
3812	2	A,B
3818	8	2 x MODEL 3814

10. FODD OUTPUTS 1 THROUGH 3 CAN BE INDEPENDENTLY CONFIGURED TO FUNCTION AS FREQUENCY OUTPUTS OR DIGITAL STATUS OUTPUTS. THEY CAN EACH BE INDEPENDENTLY CONFIGURED TO DRIVE AS TTL OR OPEN COLLECTOR.
11. EXPLOSION PROOF TRANSMITTER ENCLOSURE AND INTRINSICALLY SAFE BASE ENCLOSURE MUST BE MOUNTED IN A REMOTE LOCATION OFF THE METER BODY IF THE PROCESS TEMPERATURE EXCEEDS THE LOWER OR UPPER AMBIENT RATING -40 °C TO 60 °C (-40 °F TO 140 °F). THE ELECTRONICS MUST BE MOUNTED NEXT TO THE METER BODY ON A PIPE STAND OR OTHER RIGID STRUCTURE.

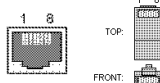
MODEL 3812:  
FOR THE MODEL 3812, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER. THE REMOTE MOUNT OPTION IS LIMITED TO THE PROCESS TEMPERATURE RANGE OF THE APPROPRIATE TRANSDUCER TYPE (SEE NOTE 17).

MODEL 3814:  
TRANSDUCER CABLES (P/N 1-380-01-801, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY FOR PROCESS FLUID TEMPERATURES UP TO 100 °C (212 °F). FOR PROCESS FLUID TEMPERATURES UP TO 150 °C (302 °F), THE HIGH TEMPERATURE TRANSDUCER CABLES (P/N 1-360-01-800, 15 FT. LONG OR 1-360-01-801, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY. IN ANY CONFIGURATION, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER.

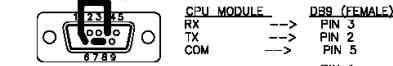
MODEL 3818:  
FOR THE MODEL 3818, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER. THE REMOTE MOUNT OPTION IS LIMITED TO THE PROCESS TEMPERATURE RANGE OF THE APPROPRIATE TRANSDUCER TYPE (SEE NOTE 17).

12. THE INTERNAL GROUNDING TERMINAL SHALL BE USED AS THE PRIMARY EQUIPMENT GROUND. THE EXTERNAL GROUND TERMINAL IS ONLY A SUPPLEMENTAL BONDING CONNECTION WHERE LOCAL AUTHORITIES PERMIT OR REQUIRE SUCH A CONNECTION.

13. COMM SIGNAL NAMING CONVENTION IS WITH RESPECT TO METER. (I.E. PC - TX -> METER - RX)
14. RJ45 SOCKET NUMBERING



15. PC SIDE SERIAL CONNECTION MUST BE WIRED FOR COMPLETE NULL MODEM FOR SUCCESSFUL HOOKUP TO METER  
NULL MODEM CONNECTIONS FOR PC END OF CABLE (RS232 WITH NO HANDSHAKING ONLY)



FEMALE 9 PIN D-SUB CONNECTOR (BACK VIEW)

## CPU MODULE DIP SWITCH SETTINGS

SWITCH	DESCRIPTION
PORT A	PORT A OVERRIDE
DHCP	DHCP SERVER ENABLE
WRITE PROT.	MEMORY PROTECT

TO ENABLE THE PORT A OVERRIDE, SWITCH MUST BE MOVED FROM THE OFF TO ON POSITION. PORT A WILL BE SET TO 19200,8,N,1 ID 32 FOR TWO MINUTES.

17. MODEL 3810 SERIES TRANSDUCERS TYPE LT-01, LT-03, LT-04, LT-05, LT-07, LT-08, LT-09, LT-10 AND LT-11.  
THE TRANSDUCERS ARE NOT INTENDED FOR USE ACROSS A BOUNDARY WALL.

THE TEMPERATURE CLASSIFICATION OF THE TRANSDUCERS IS T4 UNLESS THE ELECTRONICS ENCLOSURE IS REMOTELY MOUNTED FROM THE METER BODY. IF THE ELECTRONICS ENCLOSURE IS NOT MOUNTED TO THE METER BODY, REFER TO THE CERTIFICATION LABEL DMC-006037 ON THE METER BODY FOR THE APPROPRIATE CLASSIFICATION OF THE TRANSDUCERS, T4 OR T3.

PROCESS TEMPERATURE MUST NOT EXCEED THE OPERATING TEMPERATURE RANGE OF THE TRANSDUCERS AS INDICATED IN THE TABLE BELOW.

TRANSDUCER TYPE	PROCESS TEMPERATURE RANGE
LT-01	-50 °C (-58 °F) TO +100 °C (+212 °F)
LT-03	-50 °C (-58 °F) TO +100 °C (+212 °F)
LT-04	-50 °C (-58 °F) TO +150 °C (+302 °F)
LT-05	-50 °C (-58 °F) TO +150 °C (+302 °F)
LT-07	-196 °C (-321 °F) TO +80 °C (+140 °F)
LT-08	-50 °C (-58 °F) TO +150 °C (+302 °F)
LT-09	-50 °C (-58 °F) TO +150 °C (+302 °F)
LT-10	-50 °C (-58 °F) TO +150 °C (+302 °F)
LT-11	-50 °C (-58 °F) TO +150 °C (+302 °F)

18. THE 3810 SERIES METER HAS ONE AVAILABLE SLOT FOR AN EXPANSION MODULE.

19. FACTORY CABLE INCLUDES EXPLOSION PROOF SEAL.

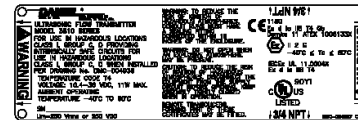
20. SECONDARY SHIELD ONLY PRESENT ON MODEL 3814 AND 3818 LNC TRANSDUCER CABLEING.

21. DIMENSIONS OF FLAMEPROOF JOINTS ARE OTHER THAN THE RELEVANT MINIMUM OR MAXIMUM SPECIFIED IN TABLE 3 OF EN/IEC 60079-1:2007. PLEASE CONTACT MANUFACTURER FOR DETAILS.

22. ALL CABLE ENTRY DEVICES SHALL BE CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE 'd', SUITABLE FOR THE CONDITIONS OF USE AND CORRECTLY INSTALLED.

23. FIELD WIRING MUST BE RATED FOR 75 °C OR HIGHER. FOR AMBIENT TEMPERATURES BELOW -10 °C (14 °F), USE FIELD WIRING SUITABLE FOR THE MINIMUM AMBIENT TEMPERATURE.
24. REFER TO THE APPROPRIATE INSTRUCTION MANUAL FOR INSTRUCTIONS FOR SAFETY INCLUDING PUTTING INTO SERVICE, USE, ASSEMBLING AND DISMANTLING, MAINTENANCE, INSTALLATION, AND ADJUSTMENT.  
MODEL 3812:  
3-9000-765 3812 INSTALLATION MANUAL  
3-9000-767 3812 MAINTENANCE AND TROUBLESHOOTING MANUAL  
MODEL 3814:  
3-9000-760 3810 SERIES INSTALLATION MANUAL  
3-9000-764 3814 MAINTENANCE AND TROUBLESHOOTING MANUAL  
MODEL 3818:  
3-9000-771 3818 INSTALLATION MANUAL  
3-9000-772 3818 MAINTENANCE AND TROUBLESHOOTING

25. LABEL FOR 3810 SERIES FLOW METER:  
DATE CODE IS INCLUDED IN THE SERIAL NUMBER. SERIAL NUMBER FORMAT SHALL BE "YY-WWXXXX" WHERE:  
YY = 2-DIGIT YEAR OF MANUFACTURE  
WW = WEEK OF MANUFACTURE (01-52)  
XXXX = SEQUENTIALLY INCREMENTING NUMBER



26. FOR THE U.L. U.S. MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE UNITED STATES:

UL 1203, 4TH EDITION  
UL 508, 17TH EDITION  
UL 913, 7TH EDITION

FOR THE U.L.-C MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN CANADA:

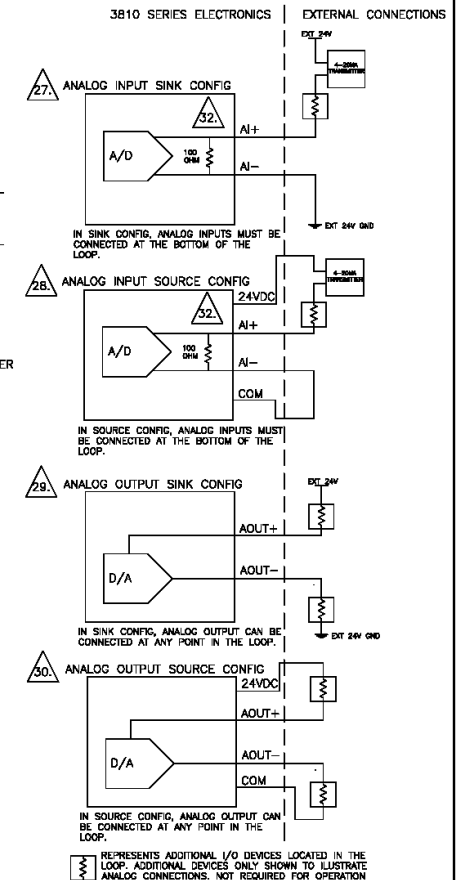
CAN/CSA C22.2 No. 30-M1986, REV. 1988-11  
CAN/CSA C22.2 No. 14-10  
CAN/CSA C22.2 No. 157-92

FOR THE ATEX MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE EUROPEAN UNION:


EN 60079-0:2009  
EN 60079-1:2007  
EN 60079-11:2007

FOR THE IECEx MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS:

IEC 60079-0:2004  
IEC 60079-1:2007  
IEC 60079-11:2006



31. ANALOG INPUT 1 AND ANALOG INPUT 2 ARE FUNCTIONALLY IDENTICAL AND ARE NOT ELECTRICALLY ISOLATED FROM EACH OTHER.
32. ANALOG INPUT 1 AND ANALOG INPUT 2 HAVE ADDITIONAL 150 OHMS LOOP IMPEDANCE FOR COMPLIANCE WITH HART COMMUNICATION REQUIREMENTS.
33. 24 VOLTS DC OUTPUT CAN BE USED TO SOURCE POWER TO ONE OR MORE OF THE ANALOG INPUTS OR OUTPUTS.
34. MODEL 3818: CABLEING TO CONNECTORS J1, J2 AND J6 ON ACQUISITION MODULE SHALL HAVE DISCRETE WIRES RESTRAINED USING SHRINK TUBING AS SHOWN ON SHEET 2.

S METRIC												THIS DRAWING IN DESIGN AND DETAIL IS OUR PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH OUR WORK. IT SHALL NOT BE REPRODUCED OR USED ON DEMAND. ALL RIGHTS ARE RESERVED.	
THIRD ANGLE PROJECTION												GEOMETRIC TOLERANCES & DIMENSIONS PER ASME Y14.5-2009 LATEST REVISION	
												UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES 2 DEC 2 DIG FRACTIONS 3/16 1/8 1/4 3/8 1/2 5/8 3/4 7/8 1 1 1/4 1 1/2 1 3/4 2 2 1/4 2 1/2 2 3/4 3 3 1/4 3 1/2 3 3/4 4 4 1/4 4 1/2 4 3/4 5 5 1/4 5 1/2 5 3/4 6 6 1/4 6 1/2 6 3/4 7 7 1/4 7 1/2 7 3/4 8 8 1/4 8 1/2 8 3/4 9 9 1/4 9 1/2 9 3/4 10 10 1/4 10 1/2 10 3/4 12 12 1/4 12 1/2 12 3/4 14 14 1/4 14 1/2 14 3/4 16 16 1/4 16 1/2 16 3/4 18 18 1/4 18 1/2 18 3/4 20 20 1/4 20 1/2 20 3/4 24 24 1/4 24 1/2 24 3/4 28 28 1/4 28 1/2 28 3/4 30 30 1/4 30 1/2 30 3/4 36 36 1/4 36 1/2 36 3/4 40 40 1/4 40 1/2 40 3/4 48 48 1/4 48 1/2 48 3/4 56 56 1/4 56 1/2 56 3/4 60 60 1/4 60 1/2 60 3/4 72 72 1/4 72 1/2 72 3/4 84 84 1/4 84 1/2 84 3/4 96 96 1/4 96 1/2 96 3/4 108 108 1/4 108 1/2 108 3/4 120 120 1/4 120 1/2 120 3/4 144 144 1/4 144 1/2 144 3/4 168 168 1/4 168 1/2 168 3/4 180 180 1/4 180 1/2 180 3/4 200 200 1/4 200 1/2 200 3/4 225 225 1/4 225 1/2 225 3/4 240 240 1/4 240 1/2 240 3/4 252 252 1/4 252 1/2 252 3/4 264 264 1/4 264 1/2 264 3/4 270 270 1/4 270 1/2 270 3/4 288 288 1/4 288 1/2 288 3/4 300 300 1/4 300 1/2 300 3/4 324 324 1/4 324 1/2 324 3/4 336 336 1/4 336 1/2 336 3/4 348 348 1/4 348 1/2 348 3/4 360 360 1/4 360 1/2 360 3/4 378 378 1/4 378 1/2 378 3/4 390 390 1/4 390 1/2 390 3/4 400 400 1/4 400 1/2 400 3/4 420 420 1/4 420 1/2 420 3/4 432 432 1/4 432 1/2 432 3/4 444 444 1/4 444 1/2 444 3/4 450 450 1/4 450 1/2 450 3/4 468 468 1/4 468 1/2 468 3/4 480 480 1/4 480 1/2 480 3/4 504 504 1/4 504 1/2 504 3/4 516 516 1/4 516 1/2 516 3/4 528 528 1/4 528 1/2 528 3/4 540 540 1/4 540 1/2 540 3/4 560 560 1/4 560 1/2 560 3/4 576 576 1/4 576 1/2 576 3/4 588 588 1/4 588 1/2 588 3/4 600 600 1/4 600 1/2 600 3/4 630 630 1/4 630 1/2 630 3/4 648 648 1/4 648 1/2 648 3/4 660 660 1/4 660 1/2 660 3/4 672 672 1/4 672 1/2 672 3/4 684 684 1/4 684 1/2 684 3/4 696 696 1/4 696 1/2 696 3/4 700 700 1/4 700 1/2 700 3/4 720 720 1/4 720 1/2 720 3/4 732 732 1/4 732 1/2 732 3/4 744 744 1/4 744 1/2 744 3/4 750 750 1/4 750 1/2 750 3/4 768 768 1/4 768 1/2 768 3/4 780 780 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3/4 2028 2028 1/4 2028 1/2 2028 3/4 2040 2040 1/4 2040 1/2 2040 3/4 2052 2052 1/4 2052 1/2 2052 3/4 2064 2064 1/4 2064 1/2 2064 3/4 2070 2070 1/4 2070 1/2 2070 3/4 2088 2088 1/4 2088 1/2 2088 3/4 2100 2100 1/4 2100 1/2 2100 3/4 2116 2116 1/4 2116 1/2 2116 3/4 2128 2128 1/4 2128 1/2 2128 3/4 2140 2140 1/4 2140 1/2 2140 3/4 2152 2152 1/4 2152 1/2 2152 3/4 2164 2164 1/4 2164 1/2 2164 3/4 2170 2170 1/4 2170 1/2 2170 3/4 2188 2188 1/4 2188 1/2 2188 3/4 2200 2200 1/4 2200 1/2 2200 3/4 2216 2216 1/4 2216 1/2 2216 3/4 2228 2228 1/4 2228 1/2 2228 3/4 2240 2240 1/4 2240 1/2 2240 3/4 2252 2252 1/4 2252 1/2 2252 3/4 2264 2264 1/4 2264 1/2 2264 3/4 2270 2270 1/4 2270 1/2 2270 3/4 2288 2288 1/4 2288 1/2 2288 3/4 2300 2300 1/4 2300 1/2 2300 3/4 2316 2316 1/4 2316 1/2 2316 3/4 2328 2328 1/4 2328 1/2 2328 3/4 2340 2340 1/4 2340 1/2 2340 3/4 2352 2352 1/4 2352 1/2 2352 3/4 2364 2364 1/4 2364 1/2 2364 3/4 2370 2370 1/4 2370 1/2 2370 3/4 2388 2388 1/4 2388 1/2 2388 3/4 2400 2400 1/4 2400 1/2 2400 3/4 2416 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## Appendix B: Open source licenses

Source code for executable files or libraries included in this product is provided per the indicated license in the table below. Hyperlinks to the controlling organization's websites are included in [Section B.1](#) through [Section B.4](#).

**Table B-1 Open source licences**

Package	File specification	License	Summary
base_libs-1.2-1	base_libs	LGPL	Base Libraries (from toolchain)
busybox-1.1.3-1	busybox	GPL	A small executable that replaces many UNIX utilities
dev-1.1-1	dev	GPL	Device files for a small embedded system
devmem2-1.0-1	devmem2	GPL	Simple program to read/write from/to any location
ethtool-3-1	ethtool	GPL	Ethernet settings tool for PCI Ethernet cards
fake-provides-1.0-5	fake-provides	GPL	Fake provides to satisfy package dependencies
gdb-6.6cs-1	gdb	GPL	Gdb - GNU Source level debugger for C, C++
kernel-2.6.37-6	kernel-2.6.37-mpc8313erd	GPL	Linux kernel (core of the Linux operating system)
libpcap-0.8.3-1	libpcap	BSD	A system-independent interface for user-level pa
libtermcap-2.0.8-31_1	libtermcap	LGPL	A basic system library for accessing the termcap
lwIP		BSD	A lightweight TCP/IP stack
merge-0.1-1	merge	GPL	Merge files for an embedded root filesystem
modeps-1.0-1	modeps	GPL	Generate module dependency file
mtd-utils-20060302-1	mtd-utils	GPL	Memory Technology Device tools
net-tools-1.60-1	net-tools	GPL	Basic networking tools
ppp-2.4.4-1	ppp	BSD	Like a Point-to-Point Protocol daemon
skell-1.16-2	skell	GPL	Skeleton files for an embedded root filesystem
sqlite-3.6.22-1	sqlite	Public domain	SQLite is a C library that implements an embeddable SQL database

Package	File specification	License	Summary
strace-4.5.14-1	strace	BSD	trace system calls associated with a running pro
sysconfig-1.2-1	sysconfig	GPL	System configuration package
sysfsutils-2.1.0-1	sysfsutils	GPL/LGPL	sysfs utilities
tcpdump-3.8.3-1	tcpdump	BSD	A network traffic monitoring tool
termcap-1.2-1	termcap	BSD	minimal /etc/termcap needed by minicom etc
u-boot-1.3.0-1	u-boot-1.3.0-mpc8313erdb	GPL	Universal Bootloader firmware
ubi-utils-1.4.2-1	ubi-utils	GPL	Tools for maintaining Unsorted Block Image Device
vsftpd-2.2.2-1	vsftpd	GPL	vsftpd - Very Secure Ftp Daemon
zlib-1.2.3-2	zlib	zlib	Distribution zlib compression utilities and libraries

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<http://www2.emersonprocess.com/en-US/brands/daniel/Pages/GPL3810.aspx>

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<http://www.gnu.org/licenses/quick-guide-gplv3.html>

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# Appendix C Index

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This product is a core component of the PlantWeb digital plant architecture.

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